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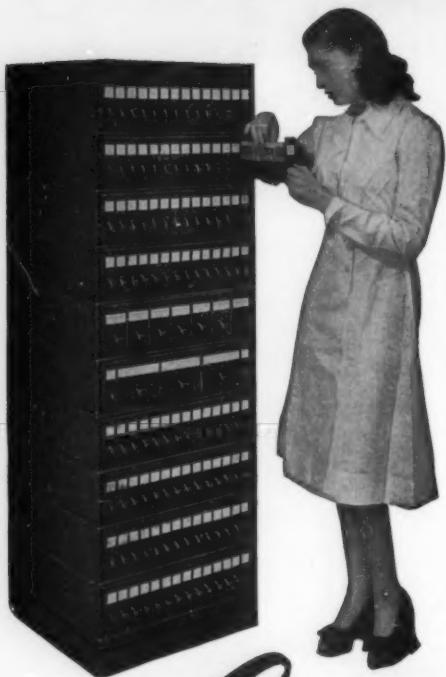
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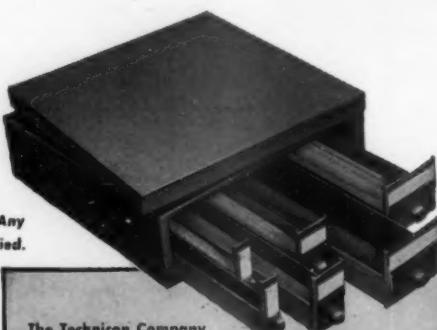
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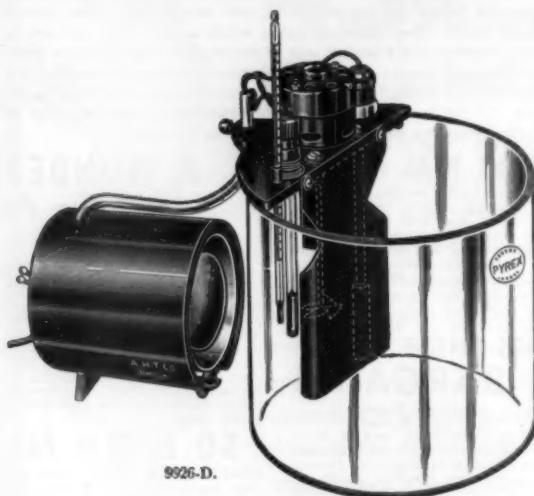
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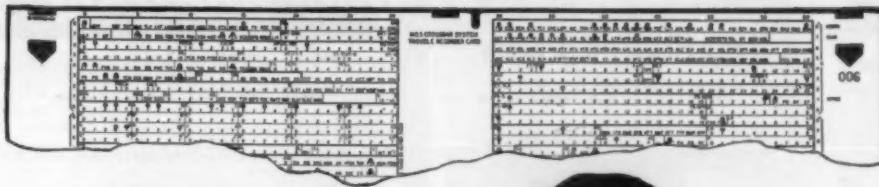


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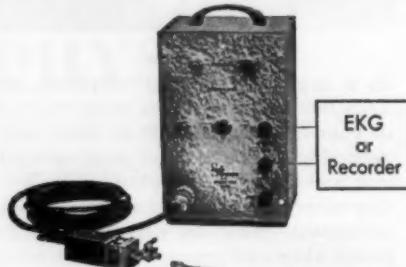
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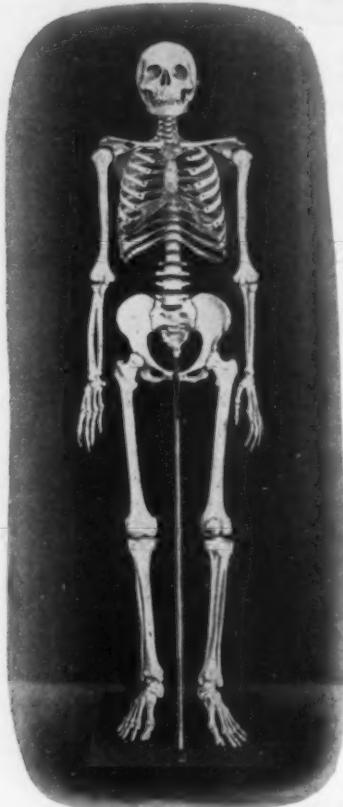
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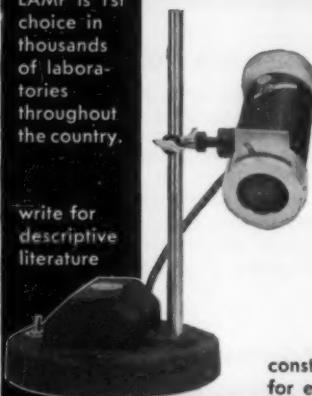
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Tritium in Nature¹

A. V. Grosse

Research Institute of Temple University, Philadelphia, Pennsylvania

W. M. Johnston, R. L. Wolfgang, and W. F. Libby

Institute of Nuclear Studies and Department of Chemistry, University of Chicago

IN RECENT YEARS the existence of natural radioearbon produced by the action of neutrons from cosmic radiation on nitrogen in the atmosphere has been demonstrated (1). The possibility that the helium-3 isotope found in atmospheric helium has its origin in the production of tritium by the action of the cosmic radiation on the air (2) has led us to examine surface waters for tritium.

The authors are indebted to the Norsk Hydro-Elektrisk Kveokstofaktievelskab of Oslo, Norway, for its whole-hearted cooperation in this research, and particularly to Directors E. Uri and V. Stephansen and Engineers J. Brun and F. Bugge. The State Department, especially Henry S. Villard and Lt. Col. Lahlum, of the U. S. Embassy in Oslo, were most helpful in arranging the transportation of samples to Temple University. In addition, we wish to thank Harold C. Urey, H. S. Taylor, A. Farkas, M. L. Oliphant, Sir John Cockcroft, Sir James Chadwick, N. Feather, and Harry Thode for their assistance in the procuring of the samples. We are further indebted to the Houdry Process Corporation, of Philadelphia, for a number of mass analyses. The assistance of A. D. Kirshenbaum and Edward Nodiff is also gratefully acknowledged.

The procedure has been to measure highly concentrated heavy water samples that have been produced from surface waters and should contain any natural tritium at about one millionfold higher concentration than the original water. It has been observed that such samples are indeed radioactive to an extent corresponding to a natural abundance of tritium of about one atom in 10^{18} atoms protium. All the measurements completed to date have been made on Norwegian waters, although measurements on waters from other localities are in progress.

The first sample examined was that described by Rutherford (3), which was 11 ml of heavy water made from 13,000 tons of ordinary Norwegian surface water in 1935-36. It was in this sample that F. W. Aston tried to detect the presence of tritium with his mass spectrograph and concluded that T/D must be less than 2 in 10^5 . Our measurements gave a tritium mole fraction of 3.2×10^{-12} . Using the probable enrichment factor for the electrolytic concentration process of 9×10^6 , we have arrived at a

¹ Presented at the First Research Day of Temple University's Research Institute, on September 14, 1950, in Philadelphia.

natural abundance of 1×10^{-18} moles of tritium per mole of ordinary hydrogen in Norwegian surface water. A second sample furnished by M. L. Oliphant from the same source but less highly enriched (calculated enrichment factor of 6×10^6) gave 5.3×10^{-18} for the mole fraction of tritium, corresponding again to a natural abundance of 1×10^{-18} . The possibility existed that these samples had been contaminated with artificial tritium in Rutherford's laboratory, so we requested the manufacturers of these original samples, the Norsk Hydro-Elektrisk Kveokstofaktievelskab, of Oslo, to prepare another set of samples analogous to those prepared for Lord Rutherford. Through the kindness of E. Uri and J. V. Stephansen three samples were prepared by J. Brun and F. Bugge at the Vemork plant, by the electrolytic method: Sample A, 2 ml of water taken from the electrolyte after the reduction of 2,950 ml of 99.74 per cent ordinary D₂O to a volume of 15 ml; Sample B, 5 ml of water formed by the combustion of electrolytic gases during the electrolysis between 20 and 15 ml electrolyte volume; Sample C, 2 ml of residue from the electrolysis after reduction of 13 ml of Sample A to 3 ml volume. The original D₂O used in the final concentration steps was also measured.

The original ordinary water for these samples, according to Norsk Hydro, "came from Lake Mösvann, which collects the water from the mountain plateau Hardangervidda in southern Norway. The height above sea level is everywhere higher than 900 meters. The Lake Mösvann water was taken into the plant at the end of January 1948, and it is likely that it originated from snow fallen during the winter 1946-47."

All D₂O samples were redistilled, combined at room temperature with pure, freshly dehydrated CaO to Ca(OD)₂, and the latter completely converted with zinc dust, at red heat, into deuterium gas, in line with the equation



In this reaction isotopic fractionation is practically excluded because of high temperature and complete conversion. All samples were analyzed on a standard Consolidated Engineering Corporation mass spectrometer for both chemical and isotopic composition. All samples were "monitored" to pure deuterium content. Our results to date are given in Table 1.

Taking the probable enrichment factor for Sample

TABLE I
DATA FOR TRITIUM IN NORWEGIAN WATERS

| Sample | Probable enrichment | Observed tritium content, g-At.T./g-At.D. | Calculated natural abundance, g-At.T./g-At.H ¹ | Age* of sample | Corrected natural abundance, g-At.T./g-At.H ¹ |
|---------------------------|---------------------|-------------------------------------------|-----------------------------------------------------------|-----------------------|----------------------------------------------------------|
| Rutherford | 9×10^4 | 3.2×10^{-18} | 0.4×10^{-18} | 1935-1949; 14 y | 0.9×10^{-18} |
| Oliphant | 1.4×10^6 | 5.3×10^{-18} | 0.4×10^{-18} | 1935-1949; 14 y | 0.9×10^{-18} |
| Sample A | 1.5×10^6 | $1.6 \times 10^{-18} \pm 5\%$ | 1×10^{-18} | Jan. 1948-1950; 1.5 y | 1×10^{-18} |
| Sample C | 2.8×10^6 | $2.8 \times 10^{-18} \pm 5\%$ | 1×10^{-18} | Jan. 1948-1950; 1.5 y | 1×10^{-18} |
| Original D ₂ O | 6×10^4 | $0.049 \times 10^{-18} \pm 10\%$ | 0.8×10^{-18} | Jan. 1948-1950; 1.5 y | 0.8×10^{-18} |

* The years given are those for the collection of water sample and counting. The actual age, based on the original snowfall or rainfall, is greater but is not known to us with any accuracy.

A as 1.5×10^6 , we calculate the natural abundance to be 1.3×10^{-18} moles of tritium per mole of ordinary hydrogen in surface water. The results on Sample C and the original D₂O are in fair agreement with this.

The separation factors assumed in the calculation of probable enrichment were 6 for deuterium vs. protium, 15 for tritium vs. protium (4), and 2.5 for deuterium vs. tritium. The rather considerable uncertainties in these separation factors as applied to the actual process utilized make it probable that our figure of 10^{-18} for the absolute abundance of natural tritium in Norwegian surface waters is not accurate to a factor better than 10.

The fact that the activity is due to tritium is insured by the following chemical considerations:

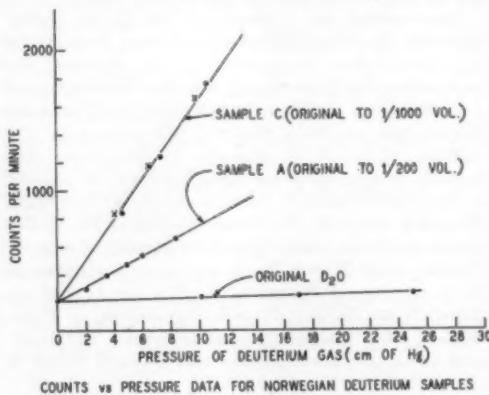
1. The activity was concentrated as a water molecule by a factor of up to 10^7 -fold; in the case of the last 3 samples of Table 1, it was followed from a 60,000-fold concentration up to 2.8×10^6 -fold enrichment.

2. Each sample was distilled from concentrated potassium hydroxide solutions during the three to four concentration stages. The final samples of D₂ gas were purified and dried over soda lime to exclude any trace of atmospheric cosmic CO₂ in the storage bulb itself.

3. The experimental separation factor of our activity to deuterium = 2.8, in going from the original D₂O to Sample A, and = 2.5 in case of original D₂O to Sample C, in good agreement with the theoretical value of 2.5 (Table 1).

Measurement of the tritium content of the deuterium samples was made by filling an ordinary flat-ended, brass wall Geiger counter with a mixture of deuterium (or hydrogen for the background determination), argon, and ethylene. The pressures used were 1-30 cm of the hydrogen gases, 3-6 cm of argon, and 1-2 cm of ethylene. It was observed that this mixture had excellent counting characteristics, very high efficiency as judged by response to an external source in comparison with a standard argon-ethylene filling in the same counter, and very satisfactory plateaus. The difference between the count rate with the deuterium filling and with an ordinary

hydrogen filling was plotted as a function of pressure of deuterium. This gave straight lines, the slopes of which were taken as measures of the inherent specific activities of the deuterium samples. Fig. 1 presents



COUNTS VS PRESSURE DATA FOR NORWEGIAN DEUTERIUM SAMPLES

FIG. 1.

these data for the recent Norwegian samples. A correction of about 3.5 per cent for end loss was made (5). The counter dimensions were 2" x 17". The half-life of tritium was taken as 12.4 years.

These results, although of limited accuracy and applicable to only one locality, make it seem rather probable that a considerable fraction, if not all, of the helium-3 observed in atmospheric helium does indeed have its origin in the cosmic ray-produced tritium. Further studies should afford a more exact check on this point.

It is worth while to point out that with a concentration of 3.10^{-18} g/g protium, cosmic tritium is by far the rarest atomic species discovered in nature. It thus has no military significance.

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Technical Papers

Probable Chromosome Number of Fossil Sequoia and Metasequoia Found in Japan¹

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In 1943, Hirayoshi and Nakamura (1) determined the chromosome number of *Sequoia sempervirens*, the coast redwood of California, as $2n = 66$, the highest number recorded for any species of conifer. Because of the lack of communication during the war period, their publication was not known outside Japan until after Stebbins (2) had independently made the same determination. In the latter publication, the chromosome number of the recently discovered *Metasequoia glyptostroboides* was determined as $2n = 22$, in common with most other species of the coniferous families Taxodiaceae and Cupressaceae.

some counts. One of these was a tree grown by the College of Forestry of Kyoto University, and studied by Hirayoshi and Nakamura (1); the other, studied by Stebbins (2), was a tree growing on the campus of the University of California, Berkeley. The specimen of living *Metasequoia* was from the same material, collected in China in 1947, which Stebbins used for determining the chromosome number. The fossil remains studied were those of both *Sequoia* and *Metasequoia* found by Miki (3) at Tokiguti, Prefecture Gihu, and those of *Metasequoia* collected by Hikita at Noboritate, Awaji, Prefecture Hyogo.

Leaves selected for study were as nearly as possible of the same size. Each leaf was prepared for study first by decolorization for a long time in ammonium hydroxide, followed by neutralization in hydrochloric acid and mounting in balsam to make a permanent preparation. For each specimen, measurements were obtained for the length and width of 100 epidermal cells and 100 stomatal

TABLE I
SIZES OF STOMATA AND EPIDERMAL CELLS IN LIVING AND FOSSIL
Sequoia AND *Metasequoia* (FIG. 2)

| Material | Stomatal length, μ | | Epidermal cells, length | | Width, μ | Chromosome no. | |
|--------------------|------------------------|----------------|-------------------------|----------------|-------------------|-----------------|-------------------|
| | N | $M \pm \sigma$ | N | $M \pm \sigma$ | | | |
| <i>Sequoia</i> | Living, California | 228 | 59.8 ± 4.28 | 100 | 139.3 ± 23.68 | 19.7 ± 4.72 | $2n = 66$! |
| | Living, Kyoto | 300 | 56.1 ± 3.63 | 100 | 128.9 ± 34.04 | 17.5 ± 4.08 | $2n = 66$! |
| | Fossil, Tokiguti | 162 | 54.6 ± 2.37 | 100 | 125.8 ± 31.04 | 18.7 ± 4.24 | $2n = 66$ (prob.) |
| <i>Metasequoia</i> | Living, China | 772 | 41.8 ± 3.12 | 100 | 50.9 ± 18.59 | 16.4 ± 3.49 | $2n = 22$! |
| | Fossil, Noboritate | 324 | 42.9 ± 2.60 | 100 | 61.5 ± 18.20 | 19.9 ± 5.52 | $2n = 22$ (prob.) |
| | Fossil, Tokiguti | 228 | 31.3 ± 3.26 | 100 | 55.2 ± 14.01 | 14.9 ± 4.88 | $2n = 22$ (prob.) |

Fossil remains of *Sequoia* and *Metasequoia*, found in abundance in the late Tertiary (Pliocene) deposits of Japan (3), resemble closely the living species. These resemblances extend to the details of cell wall structure in the well-preserved leaf epidermis of the remains. Since the differences in size of the epidermal cells, and particularly of the guard cells of the stomata, in related plant species correspond closely with differences in chromosome number, the authors have compared the fossil remains with the living material of these species with respect to the sizes of these cells. The results, reported here, suggest the probable chromosome numbers of the species of *Sequoia* and *Metasequoia* that formerly existed in Japan.

Living material of *S. sempervirens* was studied from the same two sources as those that provided the chromo-

guard cells. Means and standard deviations were calculated for each of these sets of measurements, with the following results.

1. *Stomata*: In both living *Sequoia* and its fossil remains the mean length of the stomatal guard cells was $55-60 \mu$. In *Metasequoia*, these cells were distinctly smaller, the mean being about 40μ in living material and in fossils from Noboritate, and about 30μ in those from Tokiguti (Table I and Fig. 1). From these figures, it can be seen that the guard cells of both living and fossil *Sequoia* are significantly larger than those of living and fossil *Metasequoia*, but that the differences between the living species and its fossil counterpart are in both instances very slight and not significant. Although the *Metasequoia* remains found at Tokiguti have smaller stomata than the fossils from Noboritate and the living material, the cones found at the two fossil sites closely resemble each other, so that the senior author has concluded (3) that they both belong to the same species, *Metasequoia japonica*. The number of stomata within

¹ The authors gratefully acknowledge the kindness of G. Ledyard Stebbins, Jr., of the University of California, who encouraged them to start this study, and generously furnished the necessary material. To H. Kihara, of the College of Agriculture of Kyoto University, they owe sincere thanks for kind and helpful advice throughout the work.

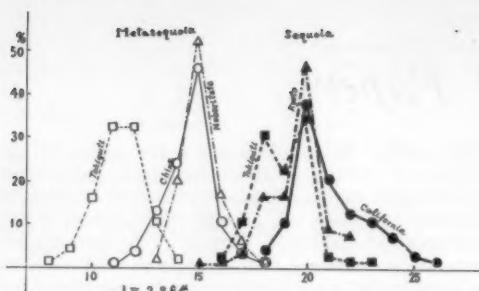


FIG. 1. Distribution of stomatal lengths in living and fossil *Sequoia* and *Metasequoia*.

a circle of 500μ in diameter was counted in various regions of the leaf, but no significant differences were found between the two genera.

2. *Epidermal cells*: As was observed by Sterling (5)

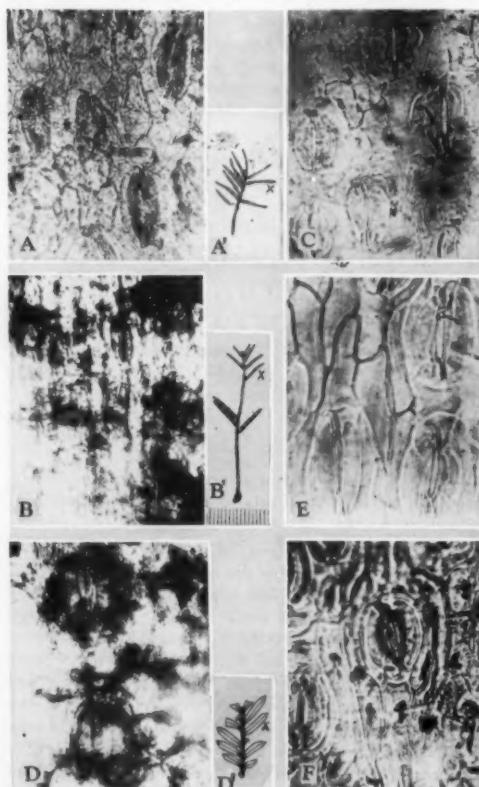


FIG. 2. A, A', *Metasequoia* from Noboritate, Awaji, Pref. Hyogo; B, B', *Metasequoia* from Tokiguti, Pref. Gifu; C, epidermis of *Metasequoia* from living species in China; D, D', *Sequoia* from Tokiguti, Pref. Gifu; E, F, epidermis of *Sequoia* from living species; E, material from Stebbins, and F, from Hirayoshi and Nakamura, A, B, C, D, E, F, $\times 400$; A', B', D', $\times 1$; x shows leaf measured.

in the living *Metasequoia*, and confirmed by the present authors in both living and fossil material, the walls of the epidermal cells in this genus are undulate, a characteristic rarely found in conifers. Since the walls of the epidermal cells are straight in both fossil and living *Sequoia*, this difference is an additional and valuable diagnostic character for separating the two genera. In respect to size, the cells of *Sequoia* are about twice as long as those of *Metasequoia*, although there are no significant differences in width (Table 1).

The close similarity in size between both the guard and epidermal cells of the fossil remains of *Sequoia* and *Metasequoia* with the corresponding cells in living plants of the same genera is strong circumstantial evidence that the fossil *Sequoia* of Japan, like the living *S. sempervirens* of California, had the chromosome number $2n = 66$, whereas the fossil *M. japonica* had the chromosome number $2n = 22$.

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Destruction of Amino Acids during Filter Paper Chromatography^{1, 2}

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Berry and Cain (1) have stated that one of the most critical operations in the preparation of a filter paper chromatogram involves removal of the solvent. They reported that the intensity of ninhydrin color which resulted from the same amount of an amino acid decreased with an increase of temperature over 80° C or with an increase in the time of heating, and they suggested that the amino acids were oxidized under these conditions. It was concluded that the solvent was best removed by blowing heated air at 85° C over the sheets for 8–10 min. Although many investigators have followed the methods described by Consden, Gordon, and Martin (2), which often involve solvent removal in an oven at temperatures up to 110° C , others have allowed the papers to dry at room temperature without giving reasons for doing so; frequently the temperature of drying is not specified in the description of experimental conditions.

Experiments summarized in the present report show that chromatograms wet with phenol should not be heated

¹ This investigation was supported in part by a grant from the American Cancer Society on recommendation of the Committee on Growth of the National Research Council.

² After this paper had been submitted, Lowden and Penny (*Nature*, 165, 846 [1950]), reported that the recovery of certain amino acids was decreased by heat-drying of paper chromatograms.

above room temperature. Almost complete disappearance of certain amino acids resulted when accepted techniques were followed (3), depending on the temperature at which phenol was removed from the paper. In one experiment, 4 two-dimensional chromatograms of alanine-2-C¹⁴^a were developed using 80% phenol as the first solvent. The second dimension was run in 63% lutidine. With all other conditions maintained constant, the phenol was allowed to evaporate from the papers at 4 different temperatures: 27°, 60°, 85°, and 105° C. The papers were kept in an oven at the 3 elevated temperatures for about 5 min. Radioautographs of these chromatograms are shown in Fig. 1. The alanine spot from the paper dried

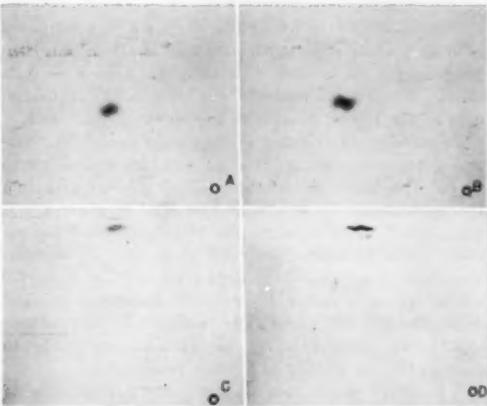


FIG. 1. Radioautographs of chromatograms of alanine-2-C¹⁴ developed first in phenol (horizontal direction) and then in lutidine (vertical direction). Origin is marked with a circle. After the phenol run, paper A was dried in front of a fan at 27° C, papers B, C, and D were dried in ovens at 60°, 85°, and 110° C, respectively.

at room temperatures shows maximum intensity (Fig. 1, A), whereas the alanine spot from the paper dried at 85° C is almost undetectable (Fig. 1, C). The loss in intensity of the alanine spot was paralleled by the appearance of one or more spots located near the lutidine solvent front. When these unknown spots were eluted and rechromatographed, they moved near the solvent front in both phenol and lutidine. The fact that they appeared directly above the alanine spot in the original chromatograms indicates that they must have been formed after the phenol run. Acid or alkaline hydrolysis of material eluted from the unknown spots led to partial recovery of the alanine which had been altered, suggesting that at least in part these compounds are dehydration products. Glycine-2-C¹⁴^a and tryptophan- β -C¹⁴ (4) were also found by radioautography to be labile to heat in the presence of phenol, with the formation of compounds showing similar high R_f values in phenol and in lutidine.

After the radioautographs had been made, these same 4 chromatograms of alanine were sprayed with ninhydrin. The intensity of the ninhydrin color at the alanine spot

^a Obtained from Oak Ridge National Laboratory on allocation from the U. S. Atomic Energy Commission.

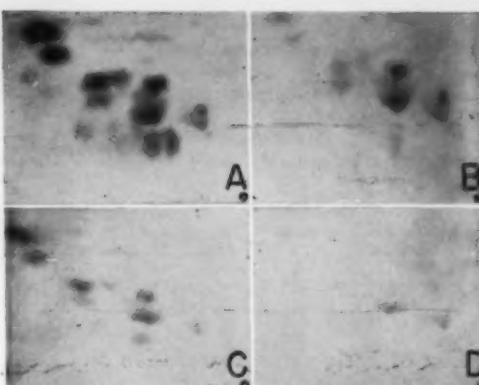


FIG. 2. Chromatograms of a casein hydrolysate developed first in phenol (horizontal direction) and then in lutidine (vertical direction). Origin is marked with a circle. Chromatograms A and B were made from 400 µg of the hydrolysate; chromatograms C and D from 100 µg. After the phenol run, papers A and C were dried in front of a fan at 27° C, and papers B and D were dried in an oven at 85° C for about 5 min.

paralleled the intensity of the radioactivity spots shown in Fig. 1. However, there was no ninhydrin color near the lutidine front in the region of the compounds derived from the alanine. Furthermore, the intensity of the ninhydrin color reaction with alanine on one-dimensional chromatograms developed with phenol was similarly dependent on the temperature at which they were dried, even though the altered compounds had not been separated from the alanine by a second solvent. This change observed with phenol did not occur when papers wet with lutidine or a butanol-propionic acid mixture (5) were heated. The phenol and water were freshly mixed for each run, and the same destruction of amino acids occurred after the phenol (Merck, reagent grade) was distilled from zinc dust.

Apparently all α -amino acids are subject to the reactions involved in this phenomenon, but not to the same extent. This is illustrated in Fig. 2 by chromatograms of a casein hydrolysate. Chromatograms A and B were made from 400 µg, and C and D from 100 µg, of the hydrolysate. Papers A and C were dried at room temperature, whereas the phenol was evaporated from papers B and D in an oven at 85° C. Most of the spots in these chromatograms may be identified by reference to the map of Dent (6). Some of the spots in Fig. 2, B are of less intensity than the corresponding spots in Fig. 2, C, which suggests that these amino acids had been reduced to less than 25% of their original amounts by the heat-drying of the paper. In contrast, other spots in Fig. 2, B are of greater intensity than the corresponding spots in Fig. 2, C, indicating that more than 25% of the original amounts of these amino acids survived the heat treatment. Comparison of the chromatograms shown in Fig. 2, C and Fig. 2, D, in which only 100 µg of the casein hydrolysate was chromatographed, shows that the treatment led to such extensive losses that only 3 ninhydrin spots were

detectable. Thus it is apparent that gross quantitative and even qualitative errors may be introduced into paper chromatography of amino acids if papers wet with phenol are heated during the drying process.

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Effect of Early Cross Transfusion on X-Irradiation Disease¹

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The literature on the direct and indirect effects of x-irradiation has been reviewed (1). The pertinent question that still remains is whether irradiation with roentgen rays results in the formation of specific and/or nonspecific toxic substances which may be transported through the circulatory system and be removed from the irradiated host, thus reducing the process of damage and degeneration on the one hand and/or increasing the process of repair and regeneration on the other. Cross-circulation has been employed to demonstrate the lack of indirect effects peculiar to radiation (1), as well as to estimate the life span of the neutrophil (2) and the thrombocyte (3). Studies with parabiotic mice indicate that nonspecific factors are carried from damaged tissue by way of the circulatory system (4). The injury incurred by these factors appears to be related to the dosage of radiation and to the volume of tissue irradiated. It has been shown that parabiosis diminishes the deleterious effect of irradiation (4).

Arterial cross circulation and parabiotic techniques are formidable surgical procedures of considerable experimental and academic interest but of relatively little practical value. Parabiosis cannot be established in the usual survival period following lethal radiation.

Cognizant of the import of the nonspecific toxicity of massive doses of irradiation and of uncombated infection as causal influences on mortality from irradiation, we have undertaken an examination of possible protective and regulatory factors of cross transfusion in the reduction of toxicity. In this report a summary of some

¹ Part of this paper is based on work performed under Contract No. W-7401-Eng-49 for the Atomic Energy Project at the University of Rochester, and Contract No. AT(04-1)-290 at the Institute for Medical Research, Cedars of Lebanon Hospital, Los Angeles 7, Calif.

² The authors gratefully acknowledge the counsel of H. Goldblatt. Technical assistance was rendered by N. Papageorge.

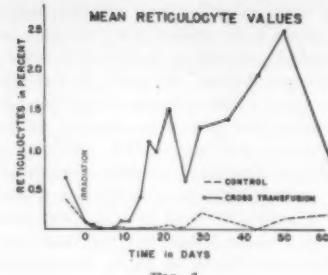


FIG. 1.

of the data obtained with the use of a cross-transfusion apparatus (5, 6) is presented. Heparin was employed with each cross circulation, and mild sedation only was administered to the donor or recipient animal as indicated. Novocaine anesthesia was used locally in the region of the 1-2-cm incision to expose the jugular vein.

Twenty-five adult mongrel dogs were used. The control group consisted of 19 dogs and the treated group of 6. The latter underwent a single cross transfusion for approximately 2 hr within 4 hr after irradiation. A quantity of blood equal to the body weight of the recipient was exchanged between each pair of animals. The donor (nonirradiated) dogs were selected from the animal colony to match in weight the respective recipient dog. Though we were fully aware of the possible hazards of incompatibility, no attempt was made to cross-match the donors with their recipients.

A standard single dose of total-body x-irradiation of 450 r^{2,4} (approximately LD 90-100%) was delivered to

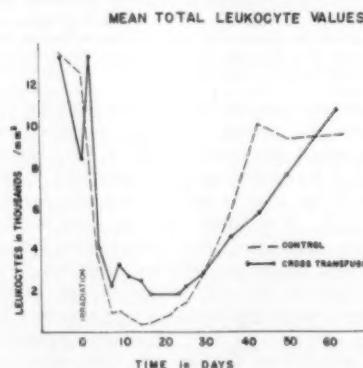


FIG. 2.

each dog used in these tests. Following the irradiation, 16 of the 19 (84%) untreated dogs succumbed in 8-25 days after x-irradiation, whereas only 2 of 6 (33%) cross-transfused dogs died 8 days after irradiation. The 4 surviving transfused dogs presented a clinical picture

³ This dosage of x-irradiation has been reported to be LD 90-100% in other laboratories (7, 8).

⁴ X-irradiation was administered from a Picker x-ray machine of 220 kvp, 15 ma, 45° ttd, and a parabolic copper filter with a half-value layer of 1.0 mm.

in sharp contrast to that of the control animals. They ate well, were moderately active, had no diarrhea or evidence of sepsis or hemorrhage. In some there was a slight local inflammatory reaction about the neck wound.

All animals that died in the treated and control groups showed depression of the hemopoietic tissues, widespread hemorrhagic manifestations, and, frequently, evidence of sepsis. In the occasional surviving control dog there was evidence of petechiae and ecchymoses in the cutaneous tissues.

Peripheral blood studies showed a depression of the total leukocytes to a mean value of 400 cells/mm² or less in the control group, whereas the cross-transfused group manifested a depression to only 1,800 cells during a corresponding period after irradiation (Fig. 1). The reticulocyte response in the control group was 0.2% or less in the entire post-irradiation period, whereas the cross-transfused dogs showed a response between 1% and 2% by the 15th day after irradiation (Fig. 2).

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Methane Gas in Water Well

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Methane gas was discovered in small amount in a water well cable-drilled by the Steel and Hodgdon Company, of Auburn, Maine, about 3.2 miles northeast of the center of the village of Winthrop in Winthrop Township. The village is about 10 miles west of Augusta, Maine, and is shown on the map of the Augusta quadrangle published by the U. S. Geological Survey. The well site is located a few feet west of Highway 135, 1.2 miles north of its intersection with State Highway 100—the Augusta road. It is near the southern nose of a low ridge that runs approximately north-south midway between Carlton Pond (elevation 340') and Lake Maranacook (elevation 210', Fig. 1).

General groundwater conditions. Several swamps at elevations ranging from 200' to 230' above sea level are within a 0.5-mile radius of the well site. Water was encountered in a well 72' deep (102' above sea level) near East Winthrop, 1.8 miles southeast of the "methane" well site. One and one-half miles north of the well site



FIG. 1. Geographic location of methane well near Winthrop, Maine. Geologic formations and structures indicated.

several wells show water at average depths of 150'-195' (or 200' above sea level). In the methane well under discussion water was not encountered until a depth of 510' was reached, or at 160' below sea level. The methane gas was encountered at about 250', but none was found below that zone.

Geologic conditions. Two sedimentary rock formations now in the middle grade zone of metamorphism (Fig. 1) are mapped in the area (1), and the contact between the two formations trends northeasterly through the southern end of the ridge 0.5 mile south of the well site. The Winthrop phyllite consists of two facies—one characterized by chloritoid (ottrelite), the other by garnet and some staurolite. Northward along the strike the phyllite passes into the low-grade metamorphosed Waterville shales of Silurian age. Underlying the Winthrop formation are the limy phyllitic beds of the Androscoggin formation, which is the nearest exposed formation to the well site. Both formations are part of a major syncline that strikes northeast and plunges slightly in the same direction. The Winthrop dark grayish-blue phyllite is fine-grained in surface exposures and is definitely foliated. Minute metacrysts of ottrelite, biotite, and a white micaceous mineral are visible. The limy phyllitic member of the Androscoggin is lighter gray in color than the Winthrop phyllite and includes visible calcite, biotite, and feldspar.

Study of well cuttings. Cable-drill cuttings taken from various depths (Fig. 2) along the wellhole show a marked change in color at a depth of about 325'. Samples from the upper portion of the wellhole are bluish-gray, and binocular examination indicated that the formation penetrated to that depth is the surface-forming Winthrop phyllite. Small chips from this portion of the well contain slender veinlets (0.5 mm) of calcite. Three % of 100-150-mesh fragments are heavier than 2.817 sp g (bromoform separation). Most of the heavy material is biotite. Screened well cuttings from 500' show 5.5% heavy mineral, which is composed of biotite, graphite, and pyrite, with the first predominating. Acid solubility was determined, and results are as shown in Table 1. Based

on observations of differences in color of the samples from the different depths, on mineral content, and on solubility, it is apparent that two different formations were encountered in drilling the well.

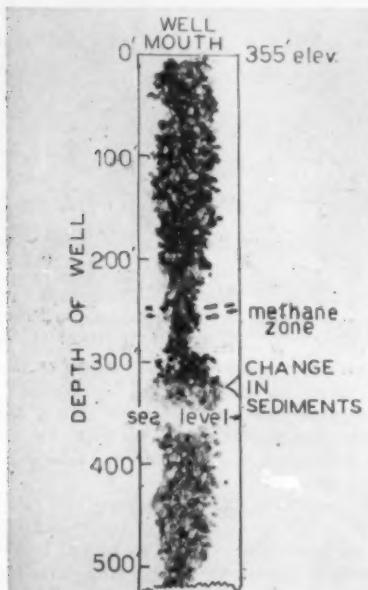


FIG. 2. Difference in lithology shown by well cuttings.

Methane gas pocket. Thayne Hodgdon, who supervised the drilling of the well, reported that no water was encountered in the hole until the depth of 500' was reached. The water obtained at 500' was decidedly cloudy but cleared after standing for about 5 hr. There was no oily

TABLE 1

| Depth, ft | Sp g | Solubility in acid | | Heavy minerals greater than 2.817, % |
|--------------|--------|--------------------|---------------|--------------------------------------------------|
| | | 1:4HCl, %† | 1:2HCl, %† | |
| 325 | 2.774* | 4.4 | 9.7 | 3 |
| 500 | 2.803* | 9.7 | 25.5‡ | 5 |

* = sp g determined by immersion method on 6 specimens from each depth.

† = 1 part acid in each acid solution; solutions were not heated.

‡ = vigorous effervescence and evolution of hydrogen sulfide.

film, but there was a decidedly gaseous odor and some bubbles. A sample of the water was brought to the Department of Geology at Bates College. Fisher made qualitative tests for chlorine, phosphate, and sulfur, finding an indefinite trace of the last. Sawyer identified the odor in the water as methane, or marsh gas. Several sterilized

bottles were supplied Mr. Hodgdon, who returned to the well site for additional samples, and who subsequently reported that, when he ignited a match close to the bubbles issuing from the water, they exploded, and there was a blue flame of brief duration.

Methane gas. Methane gas is found in many parts of the world, either pure or as the chief component of natural gas. The firedamp of mines, the sacred fires of the Chaldeans, the will-o'-the-wisp, or *ignis fatuus*, of the Irish bogs, and marsh gas are all methane. In the natural gas of commerce traces of heavier hydrocarbons and other substances may be mixed with the methane. No attempt was made in the case of the Winthrop well to test for other ingredients. The odor of the gas and the fact that it ignited and exploded sufficed to identify it.

Methane can be produced in the laboratory by a variety of methods. In nature it is the result of slow, anaerobic decomposition of organic matter, usually of plant origin. So far as the authors can ascertain, the only occurrence heretofore noted in New England is in bogs and in stagnant ponds, where it is commonly generated with the decay of vegetation buried in bottom mud. In warm weather, observation of any shallow, muddy-bottomed pond will show bubbles of the gas rising spontaneously from the mud and bursting as they reach the surface. If the bottom mud is stirred with a paddle or a stick, the gas will be evolved in greater amount. Its unpleasant, garlic-like odor is pronounced; bubbles caught at the surface can be ignited explosively with a lighted match and will emit a bluish-yellow flame.

Careful microscopic examination was made of the cuttings from the Winthrop well, and in no instance could any material of undoubtedly organic origin be found. The conclusion would follow that either the source of the gas had suffered complete disintegration, which would be exceedingly unlikely, or the gas has migrated from elsewhere.

Possible explanation. No gasoline, fuel oil, or bottled gas tanks have been, or now are, located within seepage range of the well. There is no direct surface evidence of faulting, which might give rise to a crush zone along which the gas could have migrated from its original source. There is a very minor amount of graphite in the local limestone (now limy phyllite). There is also free calcite in the phyllite. Surface waters, acid in nature, might conceivably attack the calcite and liberate carbon dioxide, but, under the conditions of temperature and pressure that exist, methane gas could not be formed. The writers know of no near-surface methane-producing reactions that can take place between the constituent minerals of the rocks present and percolating waters.

The most plausible explanation of this pocket of methane gas is that the gas migrated along the contact plane between the two local formations or along the bedding planes of the phyllites from some near-by swamp areas, or entered the zone of the wellhole through fractures in the country rock.

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Observations on the Fate of Vertebrate Erythrocytes and Hemoglobin Injected into the Blood of the American Cockroach, (*Periplaneta americana* L.)¹

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In the process of the development of a series of methods designed to demonstrate the symptoms of malfunction of various insect organ systems, an effective method was sought to bring about the diminution of the number of phagocytic cells in the blood of the American cockroach. Previous work by Yeager *et al.* (1) described the injection of carbon black and trypan blue for this purpose. Their results showed that particles of the materials were engulfed by the cells, but there was no significant reduction in the total number of cells, and complete functional elimination of the cells was not claimed.

To supply a foreign body of sufficient size, with char-

ing the blood and the introduction of this into the insect under aseptic conditions. The integument of the insect to be injected was sterilized externally by sponging the area with 70% alcohol.

There was no shock effect observed with the initial injections, but the cockroaches showed definite signs of weakness within 24 hr. Successive blood cell counts made on individuals showed a significant decrease in the number of phagocytes, and those remaining were blocked with erythrocytes and were in the process of disintegration (Fig. 1). Corresponding to the decrease in phagocytes there was always a very sharp increase in the population of a large, encapsulate, rod-shaped bacterium in the blood. The injected insects died within 72 hr; death was attributed to septicemia. The injection of citrated plasma, hemoglobin in physiological saline, hemoglobin in distilled water, or laked blood with the stroma in distilled water showed none of the above effects. From this it has been concluded that vertebrate erythrocytes are very effective in blocking and destroying the phagocytic cells of this insect; that the principal function of the blood cells of the cockroach is phagocytosis; and that the regeneration of these cells is a very slow process.

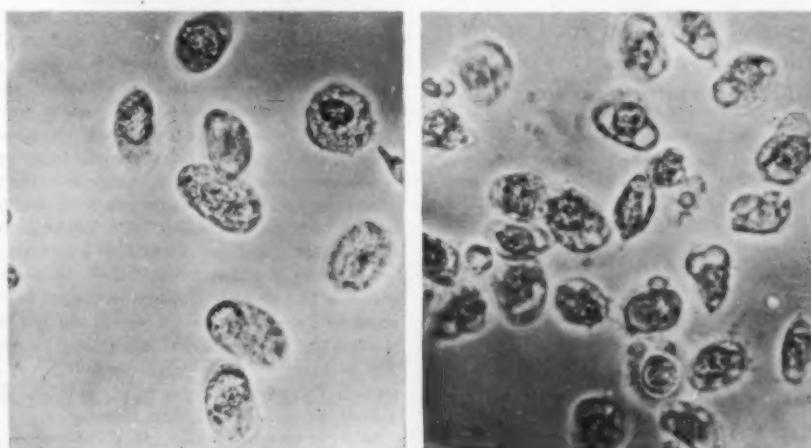


FIG. 1. Left: normal cockroach blood cells. $\times 600$. Right: cockroach blood cells blocked with bovine erythrocytes. $\times 600$.

acteristics that would render a complete blocking of the phagocytic cells of insect blood, vertebrate erythrocytes from the pigeon, cow, rat, and human were injected into the body cavities of cockroaches. The injections were made both as citrated whole blood and as suspensions of the erythrocytes in Ringer's solution. About 20 μ l of the blood or the suspension was injected per insect. More than 200 insects were injected and observed during the course of these experiments. The technique used for the injection included the usual aseptic precautions for draw-

When hemoglobin in solution was injected, the results were quite different from those reported by Wiggleworth (2), who injected this material into various blood-sucking insects, including the reduviid *Rhodnius prolixus*. In the cockroach the hemoglobin is not excreted as such, since the feces gave a negative benzidine test. The red color of the blood which was imparted by the presence of hemoglobin remained for as long as 16 days with no visible diminution of intensity as observed by the filter paper spot method. Spectrophotometric determinations of samples of blood from cockroaches that had been injected for periods up to 6 hr showed absorption maximum between 500 and 600 $\text{m}\mu$. These were identical with the absorption curves of aqueous solutions of oxyhemoglobin, a fact which indicates that no significant change in the

¹ Aided by a grant from the Division of Research Grants and Fellowships of the National Institutes of Health, Bethesda, Md.

² Rockefeller Fellow from the Superior Institute of Health, Rome, Italy.

chemical structure of the hemoglobin had occurred. This observation suggests the possibility of using hemoglobin as a dye for blood volume determination. Further development of this procedure will be described later.

Twenty-three days after the injection of hemoglobin, a low concentration of brown pigment was observed in the pericardial cells of some individuals. This was thought to be a bile pigment derivative such as was described by Wigglesworth (2), but the quantities of the material were too small for chemical determination.

The use of vertebrate erythrocytes for blocking the phagocytic cells of the cockroach, and the subsequent determination of the effects of their elimination, offer an excellent means for the comparative determination of the function of insect blood cells. Hemoglobin appears to be physiologically inert when injected into the blood of a cockroach and may offer an excellent dye for blood volume determination.

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The Influence of Amount of Food on the Reproduction Rate and Longevity of a Suctorian (*Tokophrya infusionum*)¹

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At the April 1950 meeting of the Federation of American Societies for Experimental Biology, in Atlantic City, a paper was presented by A. J. Carlson and F. Hoelzel (1) on the effect of rich, bulky, and poor diets on fertility in rats. These authors found that fertility drops greatly if food is too rich and abundant.

I have been obtaining analogous results for over a year in studies on the feeding habits of a protozoan, *Tokophrya infusionum*. *Tokophrya* is exceptionally favorable material for feeding experiments: (1) It feeds only on living ciliates (e.g., *Tetrahymena*) which become attached to its tentacles. This makes possible the regulation of the amount of food and time of feeding. (2) Both *Tokophrya* and the ciliate may be kept in bacteria-free cultures. (3) There is no limit to the amount of food ingested, and therefore it is easy to create a state of overfeeding. (4) *Tokophrya* does not reproduce by binary fission like other protozoa but by endogenous budding, and the reproducing adult survives for a period of

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² The author is indebted to Robert Chambers, in whose laboratory this work was done, for his interest and valuable suggestions; to Daniel M. Lilly, of St. John's College, Brooklyn, N. Y., for his kindness in supplying *Tokophrya infusionum* in the spring of 1948; and to Margaret E. Long for her kind assistance in editing the manuscript.

weeks or months. This makes it possible to perform experiments on the same individual for a considerable length of time. (5) The reproduction rate for individual embryos is a matter of hours.

The adult *Tokophrya*, in common with the majority of Suctoria, is sessile, being attached by a stalk to the substrate. It varies in size from 17 to 50 μ . *Tokophrya* reproduces by endogenous budding, forming one bud, the embryo, located within a brood pouch. This embryo, which is ciliated, rotates within the brood pouch for 10–20 min, and after that time is ejected. The liberated embryo swims for a variable length of time (several minutes to several hours). Metamorphosis then takes place. The embryo becomes attached to a solid substrate, loses its cilia, and forms a stalk and tentacles.

The largest number of embryos formed by one individual in 24 hr was found to be 12. This occurs only in well-fed individuals. *Tokophrya* starved for over 24 hr does not produce embryos. A young adult *Tokophrya* not fed after metamorphosis is able to form one embryo during its life, but does not reproduce at all if it comes from a poorly fed parent.

To find out to what extent the amount of food influences the reproduction rate, single *Tokophrya* were mounted in hanging drops in moist chambers with 1, 2, 3, or more *Tetrahymena*. Both *Tetrahymena* and *Tokophrya* were from bacteria-free cultures. After 24 hr counts were made only in those cases in which all the introduced *Tetrahymena* had become attached immediately to the tentacles. In these preliminary experiments it was found that there is an optimum in the amount of food consumed in 24 hr, above and below which the number of embryos decreases. If 1 *Tetrahymena* is consumed, only 1 embryo is formed within 24 hr. Two embryos are produced when 2–3 *Tetrahymena* are ingested in 24 hr. Only 1 embryo is formed in 24 hr when about 40 *Tetrahymena* are ingested, and 2 if the number is about 35. If *Tokophrya* feeds without interruption for over 24 hr, reproduction stops completely. A constantly feeding *Tokophrya* changes to a giant individual which is dark and opaque, with short tentacles.

In order to produce such giant *Tokophrya*, about 100 *Tetrahymena* were introduced into a hanging drop containing 1 adult well-grown *Tokophrya*. Such hanging drops were kept for 48 hr in moist chambers. Under these conditions no reproduction occurred, but the heavily feeding *Tokophrya* changed to a giant individual (180 μ in diameter in contrast to a normal average of 35 μ). The giant gradually lost its tentacles and after several hours disintegrated.

It was thought that the cessation of reproduction and the later disintegration of the giant individuals might be due to the accumulation of waste products in the medium. To rule out this possibility, the same experiments were repeated with certain modifications. Test tubes filled with autoclaved spring water were used instead of hanging drops. Both *Tetrahymena* and *Tokophrya* keep near the surface of a liquid medium; therefore it was not necessary to introduce a very large number of *Tetra-*

hydrometa to create conditions favorable for heavy feeding. Approximately the same amount of food was introduced into 8 tubes by means of a platinum loop. The 8 tubes were divided into two series. Series A contained 1-3 *Tetrahymena* in each of 4 tubes. Series B contained about 40 *Tetrahymena* in each of 4 tubes. In the tubes of Series A no young *Tetrahymena* were found after 48 hr. There were present only giant individuals with characteristic short tentacles, and some of the individuals had already disintegrated. A large number of *Tetrahymena* available as food was still present. On the other hand, the tubes of Series B were filled with embryos and young adult *Tetrahymena*, and had no traces of *Tetrahymena*. Repetition of these experiments gave the same results. After 48 hr about 30 *Tetrahymena* were added to each of the tubes of Series A containing only giant *Tetrahymena* and abundant food. During the next 48 hr these tubes contained embryos and healthy-looking individuals. The giant *Tetrahymena* had disintegrated. These experiments indicate that amount of food, not accumulation of waste products, causes the cessation of reproduction.

Preliminary studies show also that food influences the longevity of individual *Tetrahymena*. Since the species reproduces by endogenous budding and the same reproducing adult remains, the possibility exists of controlling the effect of food on the length of life of the individual. Without food an individual is able to survive for 2 weeks or more. Evidently underfeeding favors longevity in *Tetrahymena*. These experiments agree with the results on underfed mice reported by Tannenbaum (2).

It is of great interest to note that the amount of food ingested is an important factor in the reproduction rate and longevity of individuals both in the Mammalia and in the Protozoa. Since this relationship exists in these two far-separated phylogenetic groups, it may be a fundamental and basic biological factor affecting the life of all living organisms.

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Photoelectric Spot Analysis of Antimony and Bismuth

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The application of photometry to spot analyses was first studied by Bull (1) and Black (2). We have used a photometer having a photoelectric tube for spot analyses of antimony and bismuth ions. Two-stage amplification was used, and the intensities of light were recorded by a microammeter. Storage batteries and a small bulb were

used as a source of light. A solution filter is placed before the phototube for the purpose of obtaining nearly monochromatic light. For antimony ion, potassium chromate solution was used, and for bismuth ion, copper sulfate solution gave properly monochromatic light. The reagents used and the colored products are given in Table 1.

First, a filter paper is immersed in the reagent solution; then one drop of the test solution is dropped on it, and the colored spots are obtained on the filter paper. In the case of antimony ion, the molybdenum blue does not develop well at room temperature; hence the filter paper on which the antimony test solution is dropped is put into a steam bath for about 5 min. Molybdenum blue is produced only by the trivalent ion of antimony, so the antimony solution was made carefully, and the content of trivalent antimony ion was analyzed by ordinary chemical analysis.

TABLE 1

| Elements | Reagents | Product (color) |
|----------|------------------------------------------------------|--------------------------------------------|
| Sb | $H_3PO_4 \cdot 12MoO_3 \cdot nH_2O \cdot 5\%$ sol | Molybdenum blue (blue) |
| Bi | Cinchonine KI sol* | $BiI_3 \cdot B \cdot HI \dagger$ (pink) |

* Cinchonine 1 g.; KI 2 g.; H_2O 100 ml.; HNO_3 a few drops.

† B: organic base.

The filter paper showing a colored spot is placed between the bulb and photoelectric tube, and a screen having a small round hole (12 mm in diameter) is inserted between the bulb and the filter paper. The colored spot on the filter paper is centered on the hole, and part of the light is absorbed by the colored spot. The indicated value of the microammeter is recorded when the light transmitted through the colored spot is smaller than that through the rest of the filter paper. The value of the former is shown as I and that of the latter as I_0 . The error caused by variations of thickness of the filter paper is corrected by a blank test of each filter paper.

The results with solutions of the various concentrations of antimony and bismuth are shown in Table 2.

TABLE 2

| Content in one drop* | $I/I_0 \dagger$ % | Metallic ion | Content in one drop | I/I_0 % | Metallic ion |
|-------------------------|----------------------|-----------------|------------------------|--------------|-----------------|
| | | | | | |
| 0.18 Sb | 93.8 | Sb only | 12.8 Sb | 19.7 | Sb only |
| .30 | 89.0 | " " | 0.60 Bi | 97.0 | Bi " |
| .45 | 88.7 | Sb and Bi | 1.48 " | 94.9 | " " |
| .6 | 85.1 | Sb and Bi | 3.0 " | 86.7 | " " |
| 0.9 | 75.5 | Sb only | 4.0 " | 83.6 | Bi and Sb |
| 1.8 | 61.3 | " " | 4.8 " | 81.1 | Bi and Sb |
| 3.6 | 43.9 | " " | 5.9 " | 77.7 | Bi only |
| 6.4 | 35.1 | " " | 11.9 " | 69.9 | " " |
| 9.0 | 28.9 | " " | 29.7 " | 54.0 | " " |

* The volume of one drop is 0.032 ml.

† Mean value of 3 determinations.

Interference between Bi and Sb was not noticeable. The writer applied this method to an analysis of Bi ~ Sb

sulfide mineral from the Horobetsu sulfur mine (Hokkaidō, Japan) with success.

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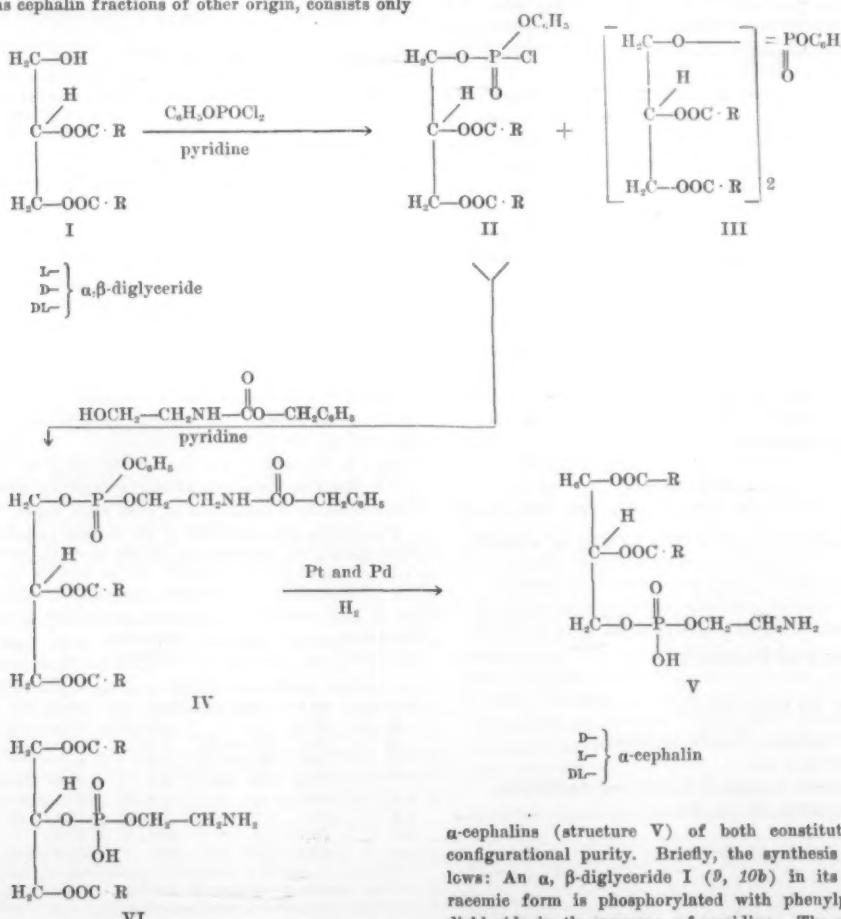
Synthesis of Enantiomeric α -Cephalins¹

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Folch (1-4), Wooley (2, 5), Hutt (6), and their associates have shown that Thudichum's ox brain cephalin, as well as cephalin fractions of other origin, consists only

partially of phosphatidyl ethanolamine, which is known classically as cephalin and to which have been assigned structures V and VI. Associated with it are variable amounts of phosphatidyl serine and other complex phosphoric acid esters containing inositol, galactose, and as yet unidentified nitrogenous constituents. A study of the biological role of the various components of the "cephalin fraction" requires accessibility to the pure substances. The difficulties encountered in isolating pure individual cephalins (phosphatidyl ethanolamines) from natural sources have prompted several attempts (7, 8) to obtain these compounds by synthesis. None of these attempts to synthesize the α -cephalins, however, can be considered truly successful.

The authors herein report a procedure which is generally applicable to the synthesis of fully saturated



¹ This work has been made possible by a grant of the Nutrition Foundation, Inc., to one of us (E. B.).

α -cephalins (structure V) of both constitutional and configurational purity. Briefly, the synthesis is as follows: An α , β -diglyceride I (*9*, *10b*) in its *D*-, *L*-, or racemic form is phosphorylated with phenylphosphoryl dichloride in the presence of pyridine. The main reaction product II, the diacyl α -glycerylphenylphosphoryl dichloride, without isolation from III, is immediately

esterified with carbobenzoxyethanolamine (11). The reaction mixture is brought to dryness *in vacuo*, the diacyl α -glycerylphenylphosphoryl carbobenzoxyethanolamine IV is isolated by extraction with petroleum ether and is freed from impurities by treatment with ethyl acetate. The simultaneous removal of the protective phenyl- and carbobenzoxy groups by catalytic hydrogenolysis in the presence of platinum and palladium yields the desired α -cephalins V in over-all yields of 48–51%. The cephalins after precipitation from chloroform with acetone and recrystallization from dioxane are obtained in the form of microscopic spherulites, which exhibit birefringence under polarized light.

The following three L- α -cephalins were synthesized:

1. L- α -distearoyl cephalin (DSC) + $C_{18} H_{36} O_6$ NP. Found: C, 65.79; H, 10.80; N, 1.89; P, 4.16. $[\alpha]_D^{25} + 6.0^\circ$ in chloroform-acetic acid (7:1) c, 4.4; $M_D + 44.5^\circ$. Starts to sinter at 83°, melts with meniscus formation at 172°–175°.

2. L- α -dipalmitoyl cephalin (DPC) + $C_{18} H_{36} O_6$ NP. Found: C, 64.15; H, 10.66; N, 1.85; P, 4.50. $[\alpha]_D^{25} + 6.4^\circ$ in chloroform c, 7.8; $M_D + 43.5^\circ$. Sinters at 88°, meniscus formation at 172°–175°.

3. L- α -dimyristoyl cephalin (DMC) + $C_{18} H_{36} O_6$ NP. Found: C, 62.16; H, 10.41; N, 2.10; P, 4.85. $[\alpha]_D^{25} + 6.7^\circ$ in chloroform c, 8.4; $M_D + 42.5^\circ$. Sinters at 86°, meniscus formation at 175°–177°.

The three synthetic cephalins after recrystallization from warm dioxane gave distinct x-ray diffraction patterns; Debye-Scherrer powder camera (114.5-mm), radiation CuK_α (λ 1.54 K_α) nickel filter. Actual diameters in centimeters as measured on the original photographs and visually estimated relative intensities (in parentheses): Distearoyl L- α -cephalin 3.93 (0.3), 4.31 (1.0), 4.66 (0.5), 5.62 (0.1), 8.06 (0.1), 9.17 (0.3), 10.65 (0.1); dipalmitoyl L- α -cephalin 3.83 (0.4), 4.30 (1.0), 4.76 (0.4), 5.66 (0.4), 6.39 (0.1), 7.23 (0.1), 8.10 (0.3), 10.05 (0.1); dimyristoyl L- α -cephalin 3.03 (0.3), 3.46 (0.3), 3.74 (0.5), 4.34 (1.0), 4.65 (0.7), 5.98 (0.2), 7.41 (0.1), 8.00 (0.1), 9.21 (0.3).

The approximate solubilities of the synthetic L- α -cephalins in various solvents at 20° were determined. The cephalins were found to be insoluble (≥ 1 mg/100 ml of dry solvent) in acetone, ether, petroleum ether, and ethyl acetate; moderately soluble (20 mg–1,000 mg/100 ml of dry solvent) in ethanol, pyridine, benzene, and carbon tetrachloride, and readily soluble (> 1 g/100 ml of

solvent) in chloroform. The solubility of the cephalins increases with decreasing length of the fatty acid chain. As might have been anticipated, the three synthetic α -cephalins are considerably less soluble than the corresponding α -lecithins (10 a, b). It is of interest to note in this connection that Folch has reported that the phosphatidyl ethanolamine isolated by him is readily soluble in alcohol. It is possible that this greater solubility of the natural substance is explained by the degree of unsaturation of its fatty acids.

It is well known that glycerol derivatives are optically active only when asymmetrically substituted. As has been discussed more fully elsewhere (10 a, b; 12), asymmetrically tri-substituted derivatives of glycerol can be assigned to either one of the two optical series (D- or L-). Hence in the case of α -cephalins (α -phosphatidyl ethanolamine) any particular member can be considered either as derivative of its diglyceride moiety or of glycerylphosphorylethanolamine (GPEA). The choice made, as in the case of the corresponding α -lecithins (10 a, b), has been influenced by biological as well as chemical considerations. Because the GPEA moiety is the same in every α -cephalin, it has been chosen as the stereochemical compound of reference. Thus arbitrarily, but in conformity with the adopted usage in the α -lecithin series (10 a, b), an α -cephalin is assigned the L-configuration if it contains L- α -GPEA and the D-configuration if it contains D- α -GPEA.

The synthetic procedure described above makes available for the first time pure enantiomeric forms of individual α -cephalins. The experimental details will be reported shortly elsewhere.

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Comments and Communications

Replacement Control and Biological Control

This note is prompted by the writers' interest in the control of pest plant species through natural replacement by desirable species. Our purpose is to compare replacement control with "biological control," which denotes control of insect or plant pests by parasitic or predatory organisms. References to biological control in current literature do not include control by replacement. *The Control of Weeds* (Whyte, R. O., Ed. Aberystwyth, Great Britain: Imperial Bur. of Pastures and Forage Crops, Bull. 26, Jan. 1940) and *Weed Control* (Robbins, W. W., Crafts, A. S., and Raynor, R. N. New York: McGraw-Hill, 1942), both of which refer to the work of many investigators, do not recognize replacement as a method of biological control.

Replacement control and biological control are similar in that both employ natural means, and both require man's intervention to create conditions favorable for the restrictive process to begin its course. In biological control the objective tends to be specific, such as the control of a particular pest (prickly pear cactus) by a particular kind of organism (moth-borer). In replacement control, though the immediate objective may also be the elimination of a particular kind of plant species, the process involves the control of other plants of similar habits of growth. Furthermore, its objective may be multiple in effect, as: control of a plant pest, plus control of an insect that is the vector of a disease, and, consequently, control of the disease, plus improved forage, plus improved plant cover as a protection for the soil.

Biological control makes use of a predator-prey or a host-parasite relationship. A specific parasite or predator must be found and introduced free of its own parasites and predators, and it must be harmless to useful species. If an endemic organism is to be used, the conditions that favor its development and activity must be discovered.

Replacement control makes use of the natural process involved in secondary plant successions, and it applies almost exclusively to uncultivated lands and usually to those used for grazing. The kind of replacement used on cultivated lands, that of obtaining a dense, vigorous stand of crop plants to eliminate certain kinds of weeds, makes use of only one part of the process of plant succession, namely, competition. The time is usually short, involving only the current generation of plants. Replacement by means of secondary successions requires a few to many years and successive generations of plants. It is a complex process involving a series of plant communities, even though these communities themselves may be simple as compared to the original stable plant communities. For instance, in semidesert vegetation the process of replacement goes forward from an initial simple community of summer annuals, through another of broad-leaved winter annuals (not grasses), then winter annual grasses, to native perennial grasses and shrubs. These native perennials form stable communities similar to the original, even if not identical as to all the minor, associ-

ated species. Thus in any strict sense the reestablishment of stable communities of native perennials is not a complete return to the climax.

In replacement control, man's part is to protect the vegetation of the area from destruction by animals by excluding domestic animals for the necessary time and, if needed, by temporarily reducing such wild animals as rabbits and other small rodents. If this is done, there will be, in time, a successful control of the obnoxious weed species. An illustration taken from actual demonstrations in a semidesert vegetation can be given: Russian thistle replaced by a growth of mustards, and the latter in turn replaced by a cover of downy chess. The first, a summer annual that is a pest in itself in crops such as grain, is also a favorable summer host for the breeding of the beet leafhopper, vector of the virus of the disease called curly top. The second, the mustards, also weeds, are winter annuals and are also favorable winter and spring hosts of the beet leafhopper. The third, downy chess, a winter annual grass, is not a host for the beet leafhopper, yields more forage than either of the others, and affords better protection for the soil. The entire change from the first stage, Russian thistle, to the third, the annual grass, taken place in 5 or 6 years (Piemeisel, R. L., *Natural Replacement of Weed Hosts of the Beet Leafhopper as Affected by Rodents*. U. S. Dept. Agri. Cir. 739, 1945). Under proper conditions this temporary cover of quick-growing annuals is in turn replaced by native perennials, grasses, and shrubs that yield a more stable cover and more reliable forage, and are not favorable for the building up of a large number of beet leafhoppers.

Although the two methods of control are alike in that they both employ natural means, biological control is similar to chemical and mechanical methods of control in its dependence on direct destruction of the pest, whereas replacement control depends on prevention of growth or on indirect destruction through crowding and competition. Biological control has been put into practice in a number of instances; for example, on cactus in Australia and on insects in citrus-growing districts. Control by replacement has scarcely made a beginning in practice, but it has great potential possibilities for the future. Though this method has not been used intentionally as a control of particular pests on any large scale, some of its underlying principles have been tried or advocated for a long time in the improvement of plant cover on grazing lands, where the objective has been increased forage or better protection for the soil. Good range management includes replacement of pest plant species, which is the best means of controlling them.

The effectiveness of replacement control for any given case can be determined by appropriate experimental procedure. Experience with curly top indicates that the time required to make replacement effective compares favorably with the time required for effective control through the development of resistant varieties. As a long-term solution the method is undoubtedly less expen-

sive than other methods, such as (1) mechanical (cultivating, hoeing, mowing, etc.), (2) chemical (dusting, spraying), and (3) fire, which generally entails recurring efforts and expense.

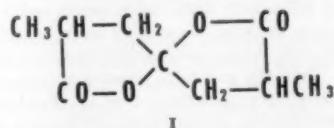
The term biological control, taken in its broadest sense, should include control by replacement through plant successions. If its present meaning, which limits it to the action of parasitic and predatory organisms, is to be continued, then replacement control or some term more appropriate for the process involved may become coordinate with biological control. Communications are requested from those interested in this problem of terminology and also from those who know of any instance where a term has already been used for the method of control that makes use of plant successions.

ROBERT L. PIEMEISEL
EUBANKS CARSNER

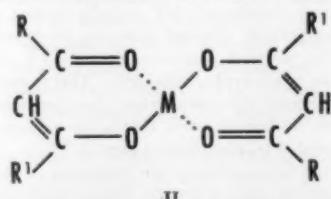
Division of Sugar Plant Investigations,
Bureau of Plant Industry, Soils, and
Agricultural Engineering, ARA, USDA,
Twin Falls, Idaho, and Riverside, California

Solution of the Problem of "Internal Compensation" in Meso Compounds as Afforded by Studies on Analogous Coordination Complexes

A controversy concerning the meaning of "internal compensation" in meso compounds—whether meso compounds with staggered configurations are optically active—has occurred in past issues of SCIENCE (Noller, 102, 508 [1945]; Wright, *Ibid.*, 104, 190 [1946]). In a recent communication (*Ibid.*, 112, 26 [1950]), Kurt Mislow proposed an experimental solution of the problem: the resolution of DL-isomers of spirans such as 3,8-dimethyl-1,6-dioxaspiro [4.4]-nonane-2,7-dione (I).

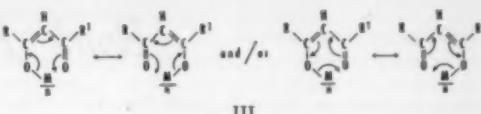


Certain 4-coordinate complexes of 1,3-dione-type compounds with divalent and trivalent cations are fully analogous to these spirans (II).

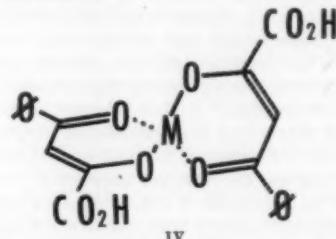


such compounds behave as if they consist of two 6-membered rings joined at the metal atom in spiran fashion; e.g., the compounds undergo no reactions that are characteristic of free carbonyl groups (Werner, *Ber.*, 34, 2584

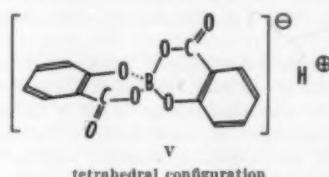
[1901]). The resonance picture in III explains this behavior.



Several examples of this type of coordination complex have been successfully shown to possess optical activity: bis(4-phenyl-2,4-dioxobutanoato-2,4-O,O) beryllium (II) and the corresponding zinc compound (IV), by Mills and Gotta (*J. Chem. Soc.*, 3121 [1926]); and hydrogen bis(2-hydroxybenzenecarboxylato)borate (III) (V), by Boëseken (*Proc. Acad. Sci. Amsterdam*, 27, 174 [1924]). A similar silver compound is also optically active. All these examples have staggered configurations. Those that are meso but not staggered—i.e., "trans planar"—do not possess any optical activity; e.g., the Pt, Pd, Ni, and Cu complexes.



$M = \text{Zn}$ or Be ; tetrahedral configuration around M



These examples afford direct experimental proof that Noller and Mislow are correct: staggered configurations of meso compounds give rise to optical activity, just as is to be expected on the basis of the symmetry criterion.

It might be mentioned further, in view of Mislow's suggestion to resolve the DL mixture of spirans by chromatography on a lactose column, that, at least in the case of coordination complexes, chromatography on a column of finely powdered, optically active quartz is very likely to succeed. Kobayashi and Nakamura (*J. Chem. Soc. Japan*, 56, 1339 [1935]; *Bull. Chem. Soc. Japan*, 11, 38 [1936]), and Kuroya, Arini, and Tsuchida (*J. Chem. Soc. Japan*, 64, 995 [1943]) found that such quartz, shaken with solutions of certain racemic coordination complexes (similar to the use of decolorizing charcoal), preferentially adsorbed one of the optical antipodes (which one depending on the sign of rotation of the quartz).

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Book Reviews

Physical Chemistry. Walter J. Moore. New York: Prentice-Hall, 1950. 592 pp. \$5.00.

The first six chapters of this text, "designed for students in the sciences and in engineering" and possibly "useful to chemists in industry who desire a review of the subject," are devoted to a classical formulation of the fundamentals of thermodynamic theory and its application to gases, chemical equilibria, phase transformations, phase equilibria, and solutions. Included in the treatment are such topics as the proof of the lever rule, the calculation of the entropy of mixing of ideal gases, and the effect of hydrostatic pressure on vapor pressure. This is followed by individual chapters on the kinetic theory of gases, on atomistics, on nuclear physics, and on the ideas of wave mechanics. Then a chapter treats theoretical methods (e.g., the valence-bond and the molecular orbital approach) of interpreting molecular structure as well as some experimental tools providing elucidation of the constitution of molecules. A short chapter considers the Boltzmann distribution, the evaluation of partition functions and the calculation of thermodynamic quantities of chemical interest. The next two chapters deal with the results of the application of x-ray diffraction methods to crystals and liquids and a brief, qualitative discussion of modern theory of condensed phases. The final three chapters treat electrochemistry, surface chemistry, and chemical kinetics with a presentation of modern reaction rate theory.

The scope of the treatment is generally intermediate between that of the usual elementary physical chemistry text and the specialized treatise of use to the theoretical chemist. Excellence of organization, illustration, and typography are evident. A generally lucid and precise manner of presentation employed by the author enlivens the reading. Interest is further heightened by injections of paragraphs of historical significance. Occasional footnotes bear reference to research papers and sources of specific information. Chapter lists of references to treatises, monographs, and other books, as well as to informative or review articles, may encourage the student to further independent study. A generous number of stimulating problems is provided.

To present a comprehensive and varied physicochemical "smörgåsbord" in a single, conveniently sized volume requires some concessions. To provide space for emphasis of structural chemistry, the author severely minimized the discussion of topics such as ionic equilibria, titration curves, determinations of molecular weights, fractionation, and thermochemistry. Continuity and development of theoretical considerations with mathematical exactness were achieved at some sacrifice of the presentation of the experimental aspects of the subject. The treatment of electron diffraction of gases includes the derivation and

some applications of the Wierl equation; there is a 13-page discussion of x-ray diffraction of crystals, including even Fourier syntheses—yet the reviewer could find no mention of the application of neutron diffraction to structural problems. For details of mathematical apparatus, the reader is referred to standard texts.

The success of the book as an elementary text can perhaps best be judged by student response. Although considerably more material than can be presented or digested in a two-semester, elementary course is provided, judicious selection will provide a basis for a nourishing menu. The volume should prove of especially great utility to chemists and graduate students who desire a concisely yet clearly presented review of modern physical chemistry.

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Principles and Practice of Spectrochemical Analysis.
Norman H. Nachtrieb. New York: McGraw-Hill, 1950. 324 pp. \$4.50.

The first part of this book is a very skillful condensation of the background information in the varied domains of physics, chemistry, and common sense which are of interest to chemists performing or learning quantitative (and qualitative) emission spectrographic analysis. Professor Nachtrieb has included, in 70 pages of lean and carefully considered prose, all the main features of refraction and diffraction, applicable to spectrographs, as well as many interesting details. The effects of varying parameters are usually described in words and diagrams, although these are supplemented by basic formulas.

In a few cases, a more detailed mathematical derivation is given. Thus, the section on concave gratings not only gives a fairly rigorous derivation of the Rowland circle, but also includes the mathematical justification for spacing grating rulings equally along a chord of the trace of a concave grating in the horizontal plane. The latter is a rare item in textbooks. The chapters on the "Photographic Process" and "Evaluation of Photometric Data" are clear and uncluttered, and mention several advances in these fields which, although some are ten or more years old, have for the most part been greeted by a conspiracy of silence in recent texts in English. This is particularly true of the Seidel (Sampson-Baker) function, which gives an emulsion calibration curve that is linear over most of the measurable transmittance range.

One or two ambiguities in the discussion of the effects of intermittency and reciprocity failure might have been avoided if the connections between density, intensity, exposure time, and the Schwarzschild coefficient ρ had been presented in some form such as the Ahrens-Eggert three-dimensional model. Certain paragraphs in this discussion might leave the reader with the impression that intensity-

scale calibration curves made with spectral lines of different intensities are parallel only when reciprocity failure is absent (i.e., $p=1$), whereas this parallelism requires only that p be constant over the exposure range covered. This is, in fact, implicit in some of the author's statements.

The section on the origin of spectra is an excellent example of skill in concentrating a large field into a small space by making every sentence count. The presentation, although semiquantitative in many places, is a model of tight organization and effective use of diagrams. The section on the excitation of spectra is brief; it includes a summary of Kaiser and Wallraff's classic paper on spark discharges and the generation of disruptive discharges. The emphasis is very properly placed on the current flowing in the discharge, rather than on the circuit parameters. No specific mention is made of the Pfeilsticker-Sventitskii low-voltage triggered are.

The "practices" section of the book contains detailed discussions of certain exposure and sample preparation techniques selected to illustrate principles, rather than to provide laboratory directions. Resparking, electrode shapes, fractional distillation, the use of standard samples, and other topics are discussed in terms of specific techniques for analyzing liquids and solids. A section on preliminary chemical separation methods for trace analysis is accompanied by much good and heartfelt advice on chemical "asepsis" derived from the author's long experience in this field.

This book would serve as an excellent basis for a course in spectrochemistry.

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An Introduction to Nematology: Anatomy, Sect. I. Rev. ed. B. G. Chitwood and M. B. Chitwood. Washington, D. C.: B. G. Chitwood, Box 104, Catholic University, 1950. 213 pp. \$10.00.

After being out of print for several years this source book on nematodes, Section I, Parts I, II, and III, is again available, in one volume. It is intended for zoologists, helminthologists, agriculturists, and research workers in any field dealing with roundworms.

A historical résumé in Chapter I reminds us of the importance of nematodes, which annually exact a 10% toll from all crops in the United States. As parasites of domestic animals they cause a yearly loss of \$500,000,000.

Chapter II outlines the classification of free-living and parasitic nematodes, in which the class Nematoda is given the rank of a phylum. This arrangement, together with the subdivisions, makes the entire classification more comprehensible and available to the nonspecialist in taxonomy.

Chapters III to XII illustrate and discuss fully the details of the finer anatomy of some 439 species and 357 genera of both free-living and parasitic nematodes, from the cuticle to the ova. The same excellent text figures, 145 in all, are retained from the original printing, with slight rearrangement and changes in pagination. Each chapter is supplied with a well-chosen bibliography brought up to date. It is significant, however, that few

great contributions have been made since 1941; consequently, there are no large additions to the general content of the text.

The final chapter—XIII—discusses nemic relationships, origins, and evolution and gives a tabular comparison with other groups. A page and a half of abbreviation symbols and four and a half pages of an index to illustrations complete this excellent volume on nematodes.

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University of Illinois

Botany: An Evolutionary Approach. R. Darnley Gibbs. Philadelphia: Blakiston, 1950. 554 pp. \$6.00.

One difficulty that a reviewer of a textbook always faces is to judge the book from the position of the students for whom it is written. Even if the reviewer is a teacher, it is hard for him to remember how much and how little beginners in a particular field may know. It is even harder to judge whether the author's presentation of the material is explicit enough for the students to obtain the concepts and facts that were intended. It seems to this reviewer that Dr. Gibbs has been very successful, on the whole, in incorporating the information and the viewpoint that he set out to give. It is his contention that the best way to lead students into botany is to start with a discussion of the simplest plants and to work gradually through an evolutionary sequence to the study of the flowering plants. As he points out in the preface, this approach is not currently popular and serves in part, at least, as a justification for putting on the market yet another introductory botany text.

Prospective users of the book will have to decide whether they agree with the author that the evolutionary approach to plant science is best for beginning students. There can be no doubt that this approach should be available for advanced students and for general readers. The modern concepts of plant evolution have not been presented frequently enough in as clear and well-developed a manner as Gibbs achieves. This reviewer believes, however, that college freshmen and sophomores may have trouble in maintaining an interest in their botany course when they fail to learn about the familiar, conspicuous seed plants until late in the book—this despite the fact that in all the earlier chapters there are references to the usefulness or the harmfulness to man of many of the "lower" plants. Gibbs argues that students are not familiar with seed plants and are not especially interested in them. He is right that they are not familiar with them, but they think they are, and this feeling of familiarity serves to make them more interested in acquiring some knowledge of them than in learning about primitive plants first. Gibbs may be able to hold the attention of his students, for any good teacher can carry students into any field he is enthusiastic about. It is the belief of this reviewer, however, that Gibbs's *Botany* may be a hard book for many teachers to use successfully with first- or second-year college students. It should be an excellent text for advanced students.

The emphasis on evolution as the basis for organizing

present-day knowledge of plants does not mean that physiological, cytological, genetic, and taxonomic viewpoints are not well presented. In fact, a fair knowledge of biochemistry is needed to get the full import of some paragraphs—and especially the chapter on "Plant Products and their Utilization by Man." The first chapter, "The Content of Botany," lays out the whole field of plant science, but a beginning student may well not have enough understanding of the way scientific knowledge has to be organized to get much out of this in the first reading assignment. Much of its content might better be developed at the end of the book, although, of course, some introductory clue as to what botany is all about should be given.

The illustrations used are excellent and well selected;

most of them are original. The photographs are good and show what they purport to. The diagrams display evidence of having been designed by a teacher who knows what students need to be shown. The format of the whole book is pleasing, and the typography is most satisfactory. Why the text figures and the plates are not numbered in one series so that they can be found more easily needs explanation. A spot check of the index indicates that it is adequate, although it would have been helpful to have the pages where illustrations are found designated. The idea of having questions for further thought and study and a list of good reference books is commendable.

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Scientific Book Register

Maize in the Great Herbals. John J. Finan. Waltham, Mass.: Chronica Botanica; New York: Stechert-Hafner, 1950. 191 pp. \$3.00.

Industrial and Safety Problems of Nuclear Technology. Morris H. Shamos and Sidney G. Roth, Eds. New York: Harper, 1950. 368 pp. \$4.00.

The Mammals of Victoria and the Dental Characteristics of Monotremes and Australian Marsupials. National Museum of Victoria, Handbook No. 1. C. W. Brazenor. Melbourne, Australia: Brown, Prior, Anderson Pty., 1950. 125 pp. 7s. 6d., Australian.

Sir Thomas Browne: A Doctor's Life of Science & Faith. Jeremiah S. Finch. New York: Schuman, 1950. 319 pp. \$3.50.

The "Why" of Man's Experience. Hadley Cantril. New York: Macmillan, 1950. 198 pp. \$2.75.

Antipyrine: A Critical Bibliographic Review. Leon A. Greenberg. New Haven, Conn.: Hillhouse Press, 1950. 135 pp. \$4.00.

Personality and Psychotherapy: An Analysis in Terms of Learning, Thinking, and Culture. John Dollard and Neal E. Miller. New York-London: McGraw-Hill, 1950. 488 pp. \$5.00.

Microbiology: With Applications to Nursing. Catherine Jones Witton. New York: McGraw-Hill, 1950. 692 pp. \$4.50.

Feelings and Emotions. The Mooseheart Symposium in cooperation with The University of Chicago. Martin L. Reymert, Ed. New York: McGraw-Hill, 1950. 603 pp. \$6.50.

Structural Carbohydrate Chemistry. E. G. V. Percival. New York: Prentice-Hall, 1950. 246 pp. \$5.50.

Adventure into the Unknown: The First Fifty Years of the General Electric Research Laboratory. Laurence A. Hawkins. New York: Morrow, 1950. 150 pp. \$3.50.

An Autobiography. Sir Arthur Keith. New York: Philosophical Library, 1950. 721 pp. \$4.75.

The Microtomist's Vade-Mecum: A Handbook of the Methods of Animal and Plant Microscopic Technique. 11th ed. J. Brontë Gatenby and H. W. Beams, Eds. Philadelphia: Blakiston; London: J. & A. Churchill, 1950. 753 pp. \$8.50.

Chemistry: Visualized and Applied. Armand Joseph Couehaine; M. Cordelia Cowan, Ed. New York: Putnam, 1950. 687 pp. \$5.50.

Chymia: Annual Studies in the History of Chemistry, Vol. 3. Henry M. Leicester, Ed. Philadelphia: Univ. Pennsylvania Press, 1950. 250 pp. \$4.50.

Medical Entomology. 4th ed. of "Medical and Veterinary Entomology." William B. Herms. New York: Macmillan, 1950. 643 pp. \$9.00.

Electrical Engineers' Handbook: Electric Communication and Electronics. 4th ed. Harold Pender and Knox McIlwain, Eds. New York: Wiley, 1950. 23 sections. \$8.50.

Water, Land, and People. Bernard Frank and Anthony Netboy. New York: Knopf, 1950. 331 pp. \$4.00.

Principles of Nuclear Chemistry. Russell R. Williams. New York: Van Nostrand, 1950. 307 pp. \$3.75.

Applied Mycology and Bacteriology. 3rd ed. L. D. Galloway. London, Eng.: Leonard Hill, 1950. 184 pp. 12s.

Fundamentals of Optics. 2nd ed. Francis A. Jenkins and Harvey E. White. New York: McGraw-Hill, 1950. 647 pp. \$7.00.

Negative Ions. 2nd. ed. H. S. W. Massey. New York: Cambridge Univ. Press, 1950. 136 pp. \$2.50.

Introductory Nuclear Physics. David Halliday. New York: Wiley; London: Chapman & Hall, 1950. 558 pp. \$6.50.

Current Trends in the Relation of Psychology to Medicine. Wayne Dennis et al. Pittsburgh, Pa.: Univ. Pittsburgh Press, 1950. 189 pp. \$3.75.

The Sea and Its Mysteries. American edition. John S. Colman. New York: Norton, 1950. 261 pp. \$3.75.

News and Notes

Fourth Clinical Session of the American Medical Association

Austin Smith

Editor, The Journal of the American Medical Association

For more than one hundred years the American Medical Association has been holding annual meetings. These have grown so that more than 10,000 physicians now attend the sessions, which means that, with physicians, visitors, exhibitors, and their guests, approximately 25,000 or more people are present. As a result of such a large attendance, the annual sessions can be held in only three or four cities in the United States—for example, Atlantic City, Chicago, San Francisco, or New York. The clinical session was designed to permit the holding of a midyear meeting in areas not accessible for the annual meetings. The clinical sessions also serve as a postgraduate or refresher course for the general practitioners, emphasis being placed on the medical problems confronting them.

In addition to the scientific actions of the association, however, meetings of the House of Delegates are always held, at which policies are studied and adopted for the American Medical Association. Thus, each meeting, in part, consists of scientific activities and, in part, of organizational efforts. The meeting in Cleveland, which was held December 5-8, was attended by more than 2,000 physicians, most of whom were from the United States, but physicians from Canada, England, and the Latin-American countries were also included. The lectures in the scientific program embraced many aspects of practice: diagnosis and treatment of hemorrhagic diseases; cancer of the lung, stomach, and generative tract; heart failure; congenital heart disease; diabetes; diagnosis and treatment of threatened abortion; anemia in children; tests for syphilis; warts, hernia, fractures; diagnosis and treatment of head injuries and of injuries to knee and shoulder joints; use of ACTH and cortisone; spinal anesthesia; fluid balance; asthma; present status of antihistamines; and many other medical and surgical problems. Supplementing the lectures were several dozen scientific exhibits which provided practical information on a broad variety of topics, including anemia, cortisone, arterial infusion, use of cation exchange resins in edema, angiocardiography in congenital heart disease, the community heart program, thumb- and finger-sucking habits, operating room accidents, control of cancer in childhood, migraine, epilepsy, blood banks, and detection of diabetes, to mention only a few.

Of equal interest were the television programs, which presented demonstrations on operative procedures and diagnostic and treatment measures. More than thirty television demonstrations were arranged,

the transmission coming from the University Hospitals of Cleveland in cooperation with the staffs of the hospitals and of the Western Reserve University School of Medicine. Also participating were staff members of the Cleveland Clinic, St. Louis Hospital, Mt. Sinai Hospital, and Cleveland City Hospital. The telecast was received in the Cleveland Public Auditorium.

Brian Blades, chief of surgery at the George Washington University Hospital, said that lung cancer was a common form of this disease and that it apparently is increasing. Until more satisfactory therapy is available, however, the only chance of cure is through surgical removal of all or part of the lung.

Stewart Wolf, of New York Hospital, reported on the effect of mental disturbances, such as anger, resentment, and anxiety, on the stomach and intestines. He warned that abnormal activity of these organs may lead eventually to changes in the tissues and true disease. To supplement his remarks, he referred to several years' study of patients with openings through which the stomach and intestines could be observed.

ACTH and cortisone were reported helpful in the control of rheumatic fever by Arlie R. Barnes, professor of internal medicine at the University of Minnesota. The hormones do not seem to cure the disease nor shorten the usual duration, but the acute manifestations are suppressed. Associated with the use of these drugs, however, are some unusual effects such as development of moon-shaped face, appearance of acne, occurrence of white- and purple-colored markings on thighs and other parts of the body, and temporary cessation of the menses. ACTH also was reported to be remarkably beneficial in the treatment of patients suffering from burns. With this drug, pain is quickly relieved, fewer collateral measures such as transfusions are needed, nursing and medical attendance is decreased, and the skin heals much more readily and assumes a more normal appearance.

Warning against overtreatment with antihistamines, Harold J. Friedman pointed to the toxic effects that may involve the nervous system and cause symptoms such as disorientation, confusion, delirium, hysteria, and neuritis. Even the circulatory and hemopoietic systems may be involved. He urged the administration of these drugs only under the supervision of the physician, with constant observation of the patient for toxic manifestations.

Irvine H. Page said that if any of some sixty known causes of high blood pressure can be found on examination of a patient aid for the victim, or even possible cure, may be accomplished.

Edward A. Marshall, in referring to the more than one hundred conditions that may cause sudden and acute pain in the abdomen, warned that appendicitis is not the cause as frequently as has been thought. Excluding injury and diseases of the chest, he divided the causes into six groups: inflammation, stone, obstruction, ulceration, and conditions caused by interference with blood supply and by abnormal supply. He warned that in the event of abdominal pain nothing should be given at first, an enema second, food very late, and a laxative never.

Frederic A. Gibbs reported on the improved outlook for those suffering from epilepsy, because of recent discoveries in medication and surgery.

In allergy a more conservative note is necessary because of the relation of emotions to skin and other diseases and the effect of allergy on child behavior. For example, Arthur J. Horsch said that allergy in children includes more than hay fever, asthma, eczema, and hives. The allergic infant has nursing difficulties, colic, and diarrhea and vomits easily. Formulas that agree with him are difficult to find, eczema may develop from the foods to which he is allergic, and colds and bronchitis are common. Not infrequently such children present behavior problems, and it is unwise to believe that the child will outgrow this trouble. Early treatment is essential.

A surgeon, Rudolph S. Reich, reported that new methods in the treatment of hip fracture by the use of metallic nails have been effective in 85 per cent of cases by permitting healing of the break and returning the patient quickly to a useful, active life. This has been particularly helpful for the elderly, who formerly were bedridden following fractures.

Keith S. Grimson described the effect of a proprietary drug, with the trade name Bantline, on peptic ulcer. His study on a hundred patients produced results where previous medical programs had failed.

Scientists in the News

John Rusweiler Cann, who developed an instrument for electrophoretic separation of proteins, has been appointed assistant professor of biophysics in Colorado University's Department of Medicine.

Kenneth E. Caster, University of Cincinnati, has been elected vice president and member of the board of editors of the national Paleontological Research Institution and a correspondent of the new Cultural Institute of Ponta Grossa, Paraná, Brazil. Dr. Caster is associate professor of geology and a fellow in the Graduate School of Arts and Sciences at the university.

Robert R. Coles, acting head of the Hayden Planetarium for the past eight months, has been named chairman. He has been a member of the staff of the museum since 1929 and was named assistant curator in 1936. After serving in the Air Force during World

A dermatologist, Benjamin P. Persky, warned of the dangers associated with the development of frecklelike pigmentation of the skin that occurs late in life; this may be a malignant mole.

The House of Delegates made its fourth annual selection for receipt of the general practitioner's award. This year the recipient was Dean Sherwood Luce, of Canton, Massachusetts. The award is made following nominations by individual county medical societies, which are screened by the state medical societies, which in turn present one name. From these submitted names the Board of Trustees of the American Medical Association submit three to the House of Delegates. By vote, the house, which consists of 198 delegates, chooses one of these three.

An action of outstanding significance was the announcement by the Board of Trustees of an appropriation of \$500,000 as an endowment "without strings" to be given as a nucleus for a nation-wide fund for aid to medical schools. This is in addition to the quarter of a million dollars—in fact, \$285,000 for 1951—which the Association has spent annually for years through its Council on Medical Education and Hospitals and other departments to advance medical education. The half-million-dollar contribution is from the Association's National Education Campaign fund, which means that every physician as he pays his \$25.00 dues will know that a share of it, in addition to covering a subscription to *The Journal of the American Medical Association*, will be used to insure training, and better training, for medical students who are setting forth on the road he has already traveled. In making the announcement, the Board expressed the hope that this action will become a stimulus to other professions, industries, businesses, labor groups, and private donors and urged all members of the American Medical Association to contribute and to take the lead in securing contributions from other sources.

War II he returned to the planetarium, where he aided the institution's navigation training program for the armed forces. He has written extensively on astronomy, delivered 5,000 lectures in the planetarium alone, conducted a network radio program from the planetarium, and appeared on radio and television programs.

The newly created post of vice president in charge of scientific affairs, E. R. Squibb & Sons, will be held by **William A. Feirer**. For the past several years, Dr. Feirer has been executive vice president of Sharpe & Dohme, beginning in the research laboratories, and serving subsequently as medical director, director of the medical research division, and vice president in charge of medical research. He has published widely in the field of bacteriology.

Recent visitors from abroad at ARA bureaus in Washington and Beltsville were **Hans Hohn**, director of Institute of Inorganic Technology, Austria; **Pierre**

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Desnuelle, director of the National Laboratory for Oils and Fats, France; Alf Sanengen, director of Research Institute, Norway; A. M. Khan, deputy secretary of the Ministry of Food and Agriculture, Pakistan; and Gideon Mer, minister of health, Israel.

Richard O. Roblin, Jr., director of the Chemotherapy Division of the American Cyanamid Company, has been elected 1951 chairman of the American Chemical Society's Division of Medicinal Chemistry, succeeding Kenneth N. Campbell, professor of organic chemistry at the University of Notre Dame. Dr. Roblin is associate editor of the *Journal of Immunology, Virus Diseases, and Chemotherapy* and served as a civilian with the Office of Scientific Research and Development during the war. Chester Suter, associate director of research of the Sterling-Winthrop Research Institute, was elected vice chairman, and M. G. Van Campen, of the Wm. S. Merrell Company, was named secretary-treasurer.

William H. Shideler, chairman of the Department of Geology at Miami University, was honored recently at a banquet attended by 125 former students and associates. The occasion was the celebration of Dr. Shideler's 41st year of teaching geology at the University. Paul H. Dunn, chairman of the Department of Geology at Mississippi State College, was toastmaster; short talks were given by Charles Deiss, state geologist, and chairman of the Department of Geology of Indiana University, by J. J. Wolford, geologist at Miami University, and by David Delo, executive secretary, American Geological Institute—all former students of Dr. Shideler.

The chief of Veterinary Public Health Service, Communicable Disease Center, PHS, James H. Steele, attended the meeting of the international consultant group on bovine tuberculosis and other diseases communicable to man, in Geneva recently. This group, of which he is a member, is a joint unit of the WHO and FAO of the United Nations. Dr. Steele also visited several laboratories in London and the Pasteur Institute in Paris and lectured at the School of Veterinary Medicine in Paris.

The USPHS Corps has called Edward S. Weiss to active duty and has assigned him to the Arctic Health Research Center at Anchorage, Alaska. As chief of the Biometrics Branch, he will initiate studies in human ecology, including illness surveys, and will collaborate on the design and analysis of experiments in the research programs of other branches.

Meetings and Elections

Ralph W. G. Wyckoff, of the Laboratory of Physical Biology, Experimental Biology and Medicine Institute, National Institutes of Health, has discussed "Seeing Viruses and the Macromolecules of Living Matter" as a *Sigma Xi Lecturer* at several colleges and universities. In January he will speak at the following: January 10, RESA Branch, Esso Research Club,

Linden, N. J.; January 15, Socony-Vacuum Research Laboratories Club, Paulsboro, N. J.; January 16, Swarthmore College Chapter, Swarthmore, Pa.; and January 17, University of Pennsylvania Chapter, Philadelphia.

In case of military attack on the continental U. S., how will the nation's utilities continue to function? That is the subject of a panel discussion scheduled for the winter meeting of the **American Institute of Electrical Engineers** at the Hotel Statler, New York, January 22-26. Six of the institute's committees are planning to present an all-day panel discussion on the subject. In morning and afternoon sessions, January 23, they will consider the effects of the atomic bomb, radioactivity resulting from a bomb blast, instruments for indicating radioactivity, and steps being taken by the various utilities for mobilization in such an emergency.

Sigma Pi Sigma, physics honor society, held its fifth national convention at Berea College, December 27-30. As a prelude to the convention the delegates visited the Oak Ridge atomic energy installations, at one of which they were addressed by James A. Lane, associate director of the Technical Division. Dr. Lane described the current reactor programs of the AEC. The convention banquet speaker was M. H. Trytten, director of the Office of Scientific Personnel, NRC, who talked on "Physicists as National Assets." Featured at the meeting were several panel discussions on the problems facing physics students during the present national emergency.

The officers and council of the **British Association for the Advancement of Science** for 1950-51 are: president 1950, Sir Harold Hartley; president 1951, the Duke of Edinburgh; general treasurer, M. G. Bennett; general secretaries, Edward Hindle and Sir Richard Southwell; ordinary members of the council, G. C. Allen, F. Balfour-Browne, M. C. Burkitt, Ritchie Calder, T. R. Cave-Browne Cave, Sir Fred Clark, H. G. Champion, Winifred Cullis, Sir Alfred Egerton, K. G. Fenelon, H. P. Gilding, Ezer Griffiths, D. B. Harden, O. J. R. Howarth, Sir Harold Spence Jones, E. H. Neville, Sir William Ogg, S. J. F. Philpott, J. Ramsbottom, Lord Rennell of Rodd, Sir John Simonsen, W. O. Lester Smith, L. Dudley Stamp, C. J. Stubblefield, H. Hamshaw Thomas, C. Tierney, A. E. Trueman, H. E. Wimperis, A. W. Wolters, and Norman C. Wright.

Grants and Awards

Roger J. Williams, discoverer of the growth-promoting vitamin pantothenic acid and a pioneer in the development of folic acid as a weapon against pernicious anemia, has been chosen 1950 winner of the **Southwest Award of the American Chemical Society**. Director of the University of Texas Biochemical Institute since 1940, Professor Williams has aroused wide interest with his theory that, biochemically speaking, there is no such thing as "the average man,"

a theory explained in his *The Human Frontier*. He has also been the recipient of the Mead Johnson Award of the American Institute of Nutrition, and the Chandler Medal of Columbia University, which he shared in 1942 with his brother, Robert R. Williams.

David M. Ju, of Columbia-Presbyterian Medical Center, New York, and Bernard G. Sarnat, University of Illinois Colleges of Dentistry and Medicine, Chicago, are the 1950 winners of the Krebs Awards. The international essay competition is sponsored by the Foundation of the American Society of Plastic and Reconstructive Surgery, which offers the prizes for original unpublished research, basic or clinical, in plastic surgery.

Cornell University has received a grant of \$130,000 from the Lilly Endowment, Inc., of Indianapolis for a long-term research project on **Occupational Retirement and its Effects on Morbidity and Mortality**. The study is based on the belief that occupational retirement may fail to serve its commonly accepted purposes. The seven-year program will be conducted by the Cornell Social Science Research Center under the direction of Milton L. Barron, professor of sociology and a specialist in problems of aging.

The University of Michigan's Phoenix Project, devoted to atomic research, has received a grant of \$100,000 from the **Nash-Kelvinator Corporation**. The grant will be applied toward basic research on nuclear investigation of the preservation of food and the improvement of metal surfaces and coatings.

A grant of \$4,500, to be used for a research study to determine the extent of variation in the cell size and arrangement of selected portions of the brain, has been awarded to George Clark. Dr. Clark, an associate professor in Neuroanatomy at Chicago Medical School, received the grant from the **National Institute of Mental Health** through the USPHS.

The **Office of Naval Research** has recently made a grant of \$5,355 to William B. Cherry, assistant professor of bacteriology at the University of Tennessee, to support a study of host-virus relationships within the genus *Salmonella*. The Aluminum Corporation of America and TVA have extended their grants of the past year. The former provides for a continuation of studies on slime deposits in water conduits, by Arthur L. Pollard, lecturer in bacteriology, and the latter supports the studies of J. O. Mundt, associate professor of bacteriology, on studies of regional food products.

F. M. Tiller, associate professor of chemical engineering at Vanderbilt University, has won the **Junior Award of the American Institute of Chemical Engineers**. The honor is given for outstanding contributions to the literature of chemical engineering. Dr. Tiller was chosen for his paper "Efficiencies in Gas Absorption, Extraction, and Washing," published in *Chemical Engineering Progress* in 1949.

Fellowships

Opportunities for outstanding graduate students in chemistry, economics, and other scientific and technical fields to conduct research work in salaried internships will be offered during 1951-52 by the **U. S. Department of Agriculture**, in cooperation with colleges and universities throughout the country. Temporary positions as "research interns" will be available in six USDA agencies for 58 graduate students and faculty members. These internships call for full-time work by especially qualified students at salaries of \$3,100 to \$6,400 per year. By agreement with the colleges involved, interns may submit their research results for credit toward advanced degrees. Students may obtain information from their graduate schools. Appointments will be made by the department agencies concerned from qualified students nominated by accredited colleges and universities. Faculty members selected will be appointed to terms not to exceed 120 days. Nominations must be submitted by *February 1*.

The **National Gallery of Art** is sponsoring a fellowship with the objective of developing new materials and techniques for the fine arts, both for use in original work and for restoration, with a special view toward permanence. Robert L. Feller has been appointed to this fellowship. He recently completed his graduate studies at Rutgers University in the field of physical-organic chemistry and has for many years been actively interested in drawing and painting.

The **National Foundation for Infantile Paralysis** has announced the availability of pre- and postdoctoral fellowships to candidates whose interests are research and teaching in the fields related to the problems of poliomyelitis (virology, biochemistry, biophysics, orthopedics, pediatrics, neurology, and epidemiology). Predoctoral fellowships cover one year, but may be renewed; postdoctoral fellowships are for one to three years, with possibility of renewal. Stipends will range from \$1,200 to \$1,800 a year, plus tuition, to \$3,600-\$7,000 a year for the postdoctoral candidates. Further information and applications may be obtained from the Division of Professional Education, National Foundation for Infantile Paralysis, 120 Broadway, New York 5.

Industrial research fellowships in physics, chemistry, metallurgy, ceramics, mechanics, and electrical engineering are being offered by the **Armour Research Foundation of Illinois Institute of Technology**. Those awarded fellowships will attend Illinois Institute of Technology half-time, beginning in September 1951, and work in the Research Foundation half-time in a graduate program leading to advanced degrees. They will be employed full-time by the foundation during the summer. The fellowships continue for approximately 21 months, until the end of the second academic year. Candidates must be under 28 and hold a bachelor's degree from an accredited college or university, with a major in the sciences. In addition to tuition, fellows will receive \$150 a month during the

first year, \$275 a month and a two-week vacation in the summer, and \$175 a month the second year. Applications may be had from the Office of Admissions. Those received prior to *March 15* will be given first consideration.

Merek & Co., Inc., has established the **Waksman-Merck Postdoctoral Fellowship** in the natural sciences at Rutgers University. The fellowship, in honor of Selman A. Waksman, is open to U. S. and Canadian citizens who have received, or are about to receive, the Ph.D. or equivalent degree and are interested in further research experience in the basic or applied phases of biology, chemistry, or physics. The award is \$3,300 for one calendar year, beginning next *July 1*, with one month for vacation. Application forms may be obtained from the Executive Secretary, Graduate Faculty, Rutgers University, New Brunswick, N. J., and must be returned by *February 1*.

Colleges and Universities

A School of Humanities and Social Studies has been established at MIT to provide a program in general education for students in the fields of science, engineering, and architecture, which in addition will be a center for creative and professional work in such social sciences as economics. In making the announcement James R. Killian, Jr., emphasized that the creation of the new school "does not mean that MIT plans to develop a school or college of liberal arts or to give degrees in the liberal arts." John E. Burchard, dean of the Division of Humanities since 1948, has been appointed dean of the new school.

Ohio State University is establishing an Institute of Geodesy, Photogrammetry, and Cartography, the first in America to provide integration of the three sciences in such a program. Instruction and associated research will begin with the autumn quarter, 1951, under the direction of Weikko A. Heiskanen, formerly director of the Finnish Geodetic Institute.

The **University of Pennsylvania** has purchased for its Edgar Fahs Smith Memorial Collection in the History of Chemistry the historical library of the late Tenney L. Davis, which consists of nearly 1,000 volumes and a small collection of portrait prints and medals. Of interest are 24 volumes of Chinese alchemical writings, a collection of rare early European alchemical treatises, and a collection of historical studies of chemistry by modern historians.

Four educational institutions have recently been elected to active membership in the **Engineering College Research Council** of the American Society for Engineering Education. They are California Institute of Technology, Thayer School of Engineering (Dartmouth), Montana State College, and the University of Toledo.

Two hundred and fifty-five dental societies and study clubs in the U. S. and Canada are taking advantage of a new idea in education—instruction by telephone—to keep their members posted this winter on current advances in dentistry. The program will

originate in Chicago, where it will be transmitted one night a month by the **University of Illinois College of Dentistry**. More than 9,000 dentists in 46 states, and in seven provinces in Canada, will hear the two-hour telephone broadcast which started November 13, and will continue through March.

Because of the tense international situation **Rensselaer Polytechnic Institute** will accept a freshman class on February 1. This means that students finishing high school in January may complete one entire year of college before September.

A Faculty of Medicine has been established at the **University of British Columbia**, with Myron M. Weaver as dean. The preclinical departments are housed in temporary quarters on the campus, and clinical teaching will be carried on at Vancouver General Hospital and other local hospitals. Instruction during the first year is being offered in anatomy, histology, biochemistry, physiology, history of medical progress, human behavior, and introduction to medicine and public health.

In the Laboratories

At Washington, D. C., **Fisher Scientific Company** has opened a new scientific supply house which will serve as a stocking, shipping, and repair center for the Atlantic seaboard area. More than an acre of shelving has been installed in the plant to store the thousands of laboratory apparatus items, instruments, and chemicals. Complete repair, service, and demonstrations facilities are now available to scientists in the Washington area.

A **National Asphalt Research Center** has been established at the Franklin Institute Laboratories for Research and Development. It has been set up on a nation-wide scale, with sponsoring companies representing oil, roofing, molded products, linoleum, sealing compounds, and allied industries, and its basic purpose will be to further the development of a scientific technology to permit the manufacture of better asphalts for specific purposes, and the development of new applications for asphalts. The center will open officially in mid-January.

Argonne National Laboratory, which is designing production units for the manufacture of hydrogen bombs, is sponsoring a joint training and development program with **E. I. du Pont de Nemours & Co.** Scientific and technical personnel from Du Pont will train at the laboratory for periods of six to eighteen months. Du Pont will ultimately build and operate a \$260,000,000 plant in South Carolina.

Deaths

Claude Ervin Needham, chief of the Mineral Statistics Branch of the U. S. Bureau of Mines Regional Office at Amarillo, Texas, died October 15. Well known in the industry for his work in sedimentary petrography, stratigraphy, micropaleontology, and mineral economics, Dr. Needham was the editor of the *Minerals Yearbook* of the Bureau of Mines from 1943 to 1945.

Harry G. Ott, one of America's leading optical engineers and assistant to Carl L. Bausch, vice president in charge of research and engineering at Bausch & Lomb, died November 21 at 56. Head of the Military Engineering Department since 1948, he was instrumental in designing and producing optical gunfire control equipment for the Army and Navy, including rangefinders, heightfinders, tank sights, and submarine periscopes.

The recently elected president of the Geological Society of America, **Chester Stock**, died December 6. Chairman of the Division of Geological Sciences and professor of paleontology, California Institute of Technology, he was well known for his work on mammalian paleontology of western North America.

Charles Englehard, president of Baker and Company, refiners of precious metals, and an honorary life member of the Board of Trustees of Stevens Institute of Technology, died December 1. He was 83 years old.

Thousand Dollar Prize

On December 30, at the AAAS meetings in Cleveland, **Carroll M. Williams**, associate professor of zoology at Harvard University, was awarded the Association's \$1,000 Prize for an outstanding contribution to science presented at the annual convention. Born in Richmond, Va., December 2, 1916, Dr. Williams received the B.S. degree from the University of Richmond in 1937, entering Harvard for postgraduate work in biology (Ph.D., 1941) and medicine (M.D., 1946). He has been teaching at Harvard since 1946. With the assistance of six co-workers he has carried on outstanding investigative work on the physiology of the *Cecropia* silkworm. Finding that the transition from caterpillar to pupa to moth is under the control of a hormone secreted by endocrine organs, Dr. Williams and his associates analyzed the mechanism whereby this hormone directs behavior at the cellular and molecular levels, causing decay of certain proteins and the synthesis of others, and synthesizing an enzyme system named the cytochrome system, upon which growth and development are dependent. Students assisting Dr. Williams in these laboratory studies were Ned Feder, Janet V. Passonneau, Richard C. Sanborn, H. A. Schneidemann, William H. Telfer, and William Van der Kloot.

Given annually by an anonymous donor, the \$1,000 Prize is designed to encourage original scientific research and its lucid presentation at Association meetings. This year the \$1,000 prize Committee, under the chairmanship of John R. Dunning, of Columbia University, adjudged the work done and directed by Dr. Williams the most meritorious of the projects described in the 1,200 or more papers presented at the Cleveland meeting. The five papers in which the research was reported reflect Dr. Williams' long-continued interest in the physiology of insects, with special reference to the physiology and biochemistry of insect growth and development, and insect flight and respiration.

Publications Received

Electromagnetically Enriched Isotopes—Inventory, June 1950. Oak Ridge National Laboratory, Oak Ridge, Tenn.

Impact. Vol. 1, No. 1. Unesco, 19 Kléber Ave., Paris 16, France. 25¢.

Patients in State Mental Hospitals: 1948. Report MH-B50, No. 4. National Institute of Mental Health, Bethesda 14, Md.

Inundated Anthracite Reserves: Eastern Middle Field of Pennsylvania. Bureau of Mines, Bull. 491. U. S. GPO, Washington 25, D. C. 15¢.

Agricultural Climatology of Siberia, Natural Belts, and Agro-Climatic Analogues in North America. M. Y. Nuttonson. American Institute of Crop Ecology, P. O. Box 1022, Washington, D. C.

Biological Oxidation of Aromatic Rings. Biochemical Society Symposia No. 5. Cambridge Univ. Press, 51 Madison Ave., New York 10. \$2.00.

Studies Honoring Trevor Kincaid. Melville H. Hatch, Ed. Univ. Washington Press, Seattle. \$2.50.

Chicago Natural History Museum Annual Report, 1949. Chicago Natural History Museum, Chicago, Ill. \$1.00.

Effects of the Inhalation of Oxygen. Cire. 7575. Bureau of Mines, Publ. Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa.

Lamination of Connecticut Red Oak. N. V. Poletika. Bull. 537, Connecticut Agricultural Experiment Station, New Haven, Conn.

The Science Reports of the Research Institutes. Series A, Vol. 1, No. 1. Tohoku University, Sendai, Japan.

List of Danish Vertebrates. A. Fr. Brunn et al. Danish Science Press, Ltd., Copenhagen. \$1.50.

List of Scientific Papers Published in the Middle-East. Unesco, Middle East Science Cooperation Office, 8 Rue Salamlik, Garden City, Cairo, Egypt.

Man and Other Mammals from Toalian Sites in South-Western Celebes. D. A. Hooijer. Kon. Nederl. Akademie Van Wetenschappen, Amsterdam, Kolveniersburgwal 29, Holland.

Eighth Semiannual Report of the Atomic Energy Commission. Senate Doc. No. 188. U. S. GPO, Washington 25, D. C.

A Guide to the Literature on Collagen. Rubin Borasky. Eastern Regional Research Laboratory, USDA, Philadelphia 18, Pa.

British Manual on Atomic Warfare. British Information Services, 30 Rockefeller Plaza, New York 20. 50¢.

Microfilms and Microcards: Their Use in Research. Library of Congress, General Reference and Bibliography Division, Washington 25, D. C. 55¢.

Symposium on Radiation Genetics. (Information meeting for biology and medicine, AEC, Oak Ridge, Tenn., Mar. 1948.) Wistar Institute of Anatomy and Biology, Philadelphia, Pa.

Instrument Research: Catalog from Conference of Instruments and Measurements 1949. State Council of Technical Research, Royal Academy of Engineering Sciences, and Association of Technical Physicists. *Acta Polytechnica*, Box 5073, Stockholm 5, Sweden.

Contributions to Proceedings of the Second International Conference on Soil Mechanics and Foundation Engineering. Bull. 53, Vol. 46. University of Illinois, Urbana, Ill. 35 cents.



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HETEROCYCLIC COMPOUNDS, Volume II

Polycyclic Five- and Six-Membered Compounds Containing One O or S Atom. Edited by R. C. ELDERFIELD, *Columbia University*. A large group of naturally occurring compounds including anthocyanines, flavones, flavanols, chromenes, etc. are critically and exhaustively covered in book form for the first time. It concentrates on chemical principles involved in the syntheses and reactions of these compounds and presents new concepts substantiated by experimental evidence. *January 1951. 571 pages. \$15.00.*

GEOGRAPHY OF RUSSIA

By N. T. MIROV, *University of California, Berkeley*. The meat of this book is its detailed description of 20 important and widely-varying regions of the U.S.S.R. The author writes explicitly and specifically of the flora and fauna peculiar to each region and gives data on location, geology, topography, glaciation, climate, rivers, and mountains. A discussion of the people of Russia—based on first-hand information—includes historical geography, language and religion. *January. Approx. 357 pages. Prob. \$5.00.*

Laboratory Manual of ELEMENTARY ORGANIC CHEMISTRY

Second edition by G. H. RICHTER, *The Rice Institute*. Following the general plan of the first edition, it extends and supplements the basic ideas and, whenever practicable, illustrates the principal reactions and the technique of organic laboratory practice through their application to products which hold some interest for medicine. Several of the procedures have been modified either to simplify the technique or to improve the yield. *January 1951. 146 pages. \$1.80.*

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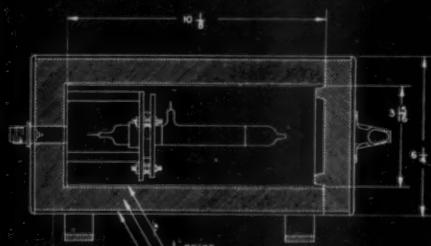
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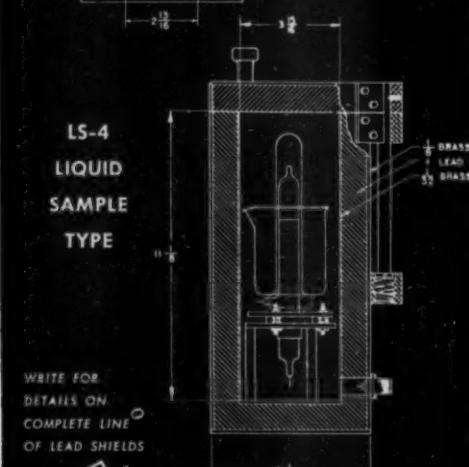
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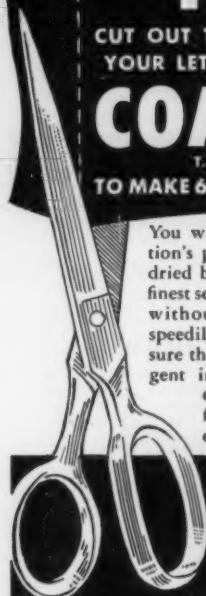
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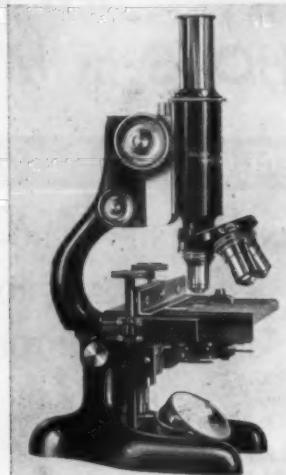
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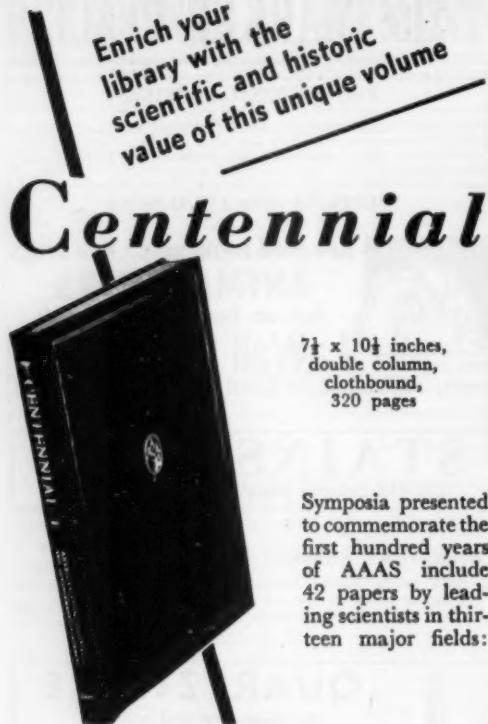
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